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BRITISH KINEMATOGRAPHY

1953

**THE BRITISH KINEMATOGRAPH SOCIETY
164 Shaftesbury Avenue, W.C.2**

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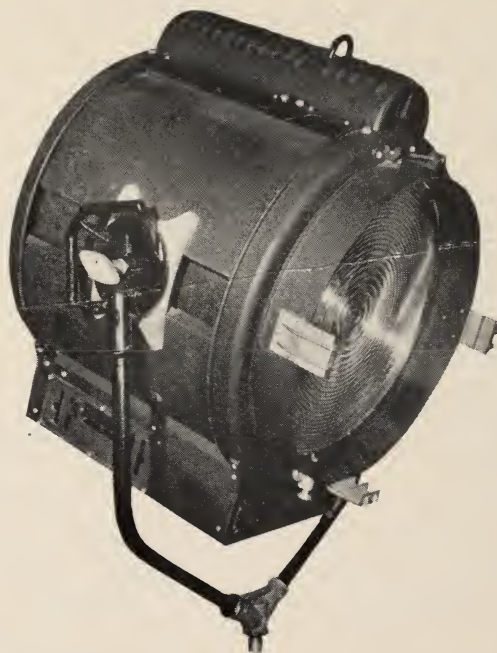
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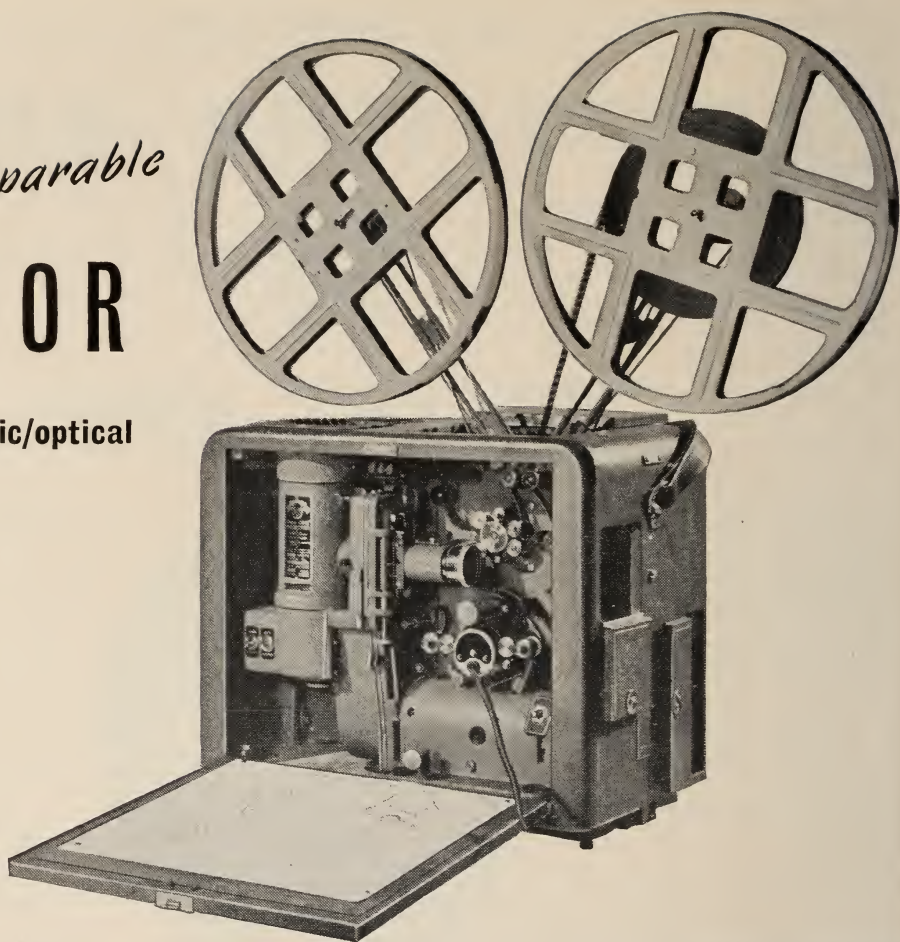
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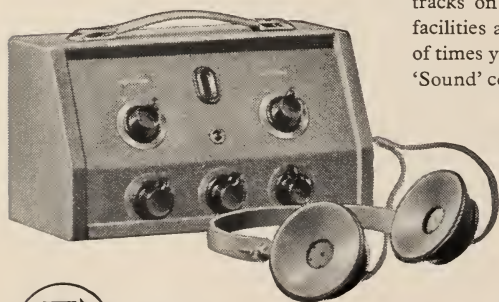
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BRITISH KINEMATOGRAPHY

VOLUME 22 No. 1

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

JANUARY, 1953

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LECTURE PROGRAMME — FEBRUARY, 1953

Meetings will be held at the Gaumont-British Theatre, Film House, Wardour Street, W.1. The evening meetings commence at 7.15 p.m. and the Sunday meetings at 11 a.m.

Feb. 4. Society
“ Production Techniques in the Making of Educational Films ”

by Frank A. Hoare (Member).
 Aspects of the production of educational and training films which can contribute to an improvement in their instructional effectiveness.

Feb. 8. Theatre Division
“ Practical Problems in the Projection Room,”
 introduced by John Parsons.

A discussion meeting on the current technical problems associated with the running of a projection suite.

Feb. 18. Film Production Division.
“ Process Projection in Colour ”
 by M. E. Harper, R. L. Houlst, A.R.P.S. (Member), and C. D. Staffell.

The special problems of process projection, both moving and still, when used for colour production and suggestions as to how the problems may be overcome. A review of modern B.P. equipment is included.

Feb. 25. 16mm. Film Division
16mm. Film Evening

Including :

**Rheumatoid Arthritis*. (4 minute excerpt). Made in colour for Ciba Laboratories, Ltd.

**Sialography Technique*. (15 minutes). Made in colour for May & Baker, Ltd.

*To be introduced by Brian Stanford, M.R.C.S., D.M.R.

It's a Matter of Taste. (19 minutes). Made in colour for Mars, Ltd., by Technical and Scientific Films, Ltd.

To be introduced by G. H. Sewell, F.R.P.S. (Member).

Neighbourhood 15. (15 minute excerpt). Made in black and white by the Look and Learn Film Unit for the British Film Institute.

To be introduced by Stanley Reed.

Red Spider. (15 minutes). Made in colour by the Shell Film Unit.

To be introduced by Alan Deller.

Admission by ticket only, obtainable from the Secretary before February 18, 1953.

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STANDARDIZATION OF SOUND QUALITY ON 16mm. RELEASE COPIES

N. Leever, B.Sc., A.C.G.I. (Fellow) *

Read to a meeting of the 16mm. Film Division on November 12, 1952

DURING the past two years, the 16mm. Sound Recording sub-committee has made a survey of recording and printing technique, a report of which will shortly be available. It is proposed that this paper be construed not as an abbreviated version of that report, but rather as an illustration of some of the work undertaken by the sub-committee, which by reason of its practical nature can occupy no prominent position in the report.

One of the most important aspects of the work has concerned the frequency response of recording and printing processes. Such distortions as flutter, scanning errors, and noise level present straightforward problems because we can all agree that the solution to be aimed at is the reduction of the distortion to the lowest level. Only the tolerances remain to be debated. In the case of frequency response, however, the issue is not nearly so clear. It is true that unlike distortions, frequency losses may be compensated for or "equalized," but our aims themselves are not so easily defined. The elimination of frequency losses or, what is more practicable, their accurate equalization is hardly the complete answer according to practical experience.

There are three major factors to be considered in film recording :

- (1) the recording characteristic ;
- (2) the film and printing losses ; and
- (3) the reproducer characteristic.

Of these, the recording and reproducer characteristics are capable of adjustment over a wide range. In printing, however, the frequency response suffers degradation, and although the amount of degradation may be minimised by good technique it cannot be reduced to zero or equalized within the pro-

cess, as may be done in the electrical processes of recording and reproduction. It is clear, therefore, that losses occurring in the printing processes must be offset by corresponding equalization applied in recording or reproduction or both, and it is convenient to examine the printing process first to see what these losses are.

Printing.

The process of making release copies is currently carried out by three major processes—optical reduction from 35mm. masters, contact printing from 16mm. masters, and electrical printing (or re-recording a direct positive track on the print). The first two processes are employed for both monochrome and colour copies, the latter for monochrome only at present.

We are primarily interested in the frequency range from 100 c/s. to 5,000 c/s. and since printing losses affect the upper rather than the lower part of this spectrum a set of test tracks were recorded, each containing the frequencies 500, 1,000, 2,000, 3,000, 4,000 and 5,000 c/s. at constant modulation depth. The set included area and density 16mm. tracks of both positive and negative characteristics, also 35mm. versions for use in optical reduction.

Test prints from these tracks were reproduced on a high quality play off head having a scanning slit of 0.00025 ins. thickness, and a linear frequency response to modulated light on the photocell. The output was measured at each frequency. The complete set of data thus obtained is included in the report, and it is sufficient for our present purpose to consider a set of typical curves shown in Fig. 1. These represent a fair cross section of the results, 500 c/s. being taken as a common reference point.

The curves represent the loss sustained at each frequency between the light modulation leaving the recording optical system and the light modulation arriving at the reproducing photocell, and they will therefore include recorder slit loss, negative film loss, printer losses, positive film loss and reproducer slit loss. The slit losses were kept very small.

No significant difference was observed between results obtained with area and density tracks. The losses are indicated with reference to the response at 500 c/s. The diagram does not show the differences in overall level exhibited by the various processes, as these do not concern us in this instance.

Curve 1 refers to a direct positive 16mm. track and is of interest in regard to printing by re-recording. With this process a worthwhile and flutter free response may be maintained well beyond the upper limit of these tests.

Curve 2 was taken from a 16mm. contact print and is fairly representative, as the results obtained with various laboratories and types of printer are remarkably consistent.

Curve 3 shows the loss in an optical reduction print. The optical reduction tests exhibited considerable variations between laboratories and machines, and even within the same test strip in some instances, while the general volume level is noticeably down compared with contact prints.

Curve 4 was taken from a 16mm. Kodachrome contact print and here there was good agreement between tests but some loss of output.

Curve 5 is the best of four obtained by optical reduction on Kodachrome. The loss at 5 kc/s. is considerable compared with contact printing, and this method of obtaining Kodachrome duplicates is not recommended.

From these curves we see that with reference to the output at 500 c/s. the losses at 5 kc/s. for the five processes are respectively:—

- (1) Direct positive — 5 db.
- (2) Contact print (monochrome) — 8db.
- (3) Optical reduction (monochrome) — 11 db.
- (4) Contact print (Kodachrome)—12 db.
- (5) Optical reduction (Kodachrome) — 17db.

Although these results are fairly representative of modern laboratory practice, it is undoubtedly true that prints showing even greater extremes of high frequency response are in general circulation, and it is most undesirable that the projectionist should be expected to make major adjustments to accommodate them. In order to obtain prints by these different processes which will be of a high standard and yet be a satisfactory match with one another, the balancing up of the frequency characteristics should therefore take place in recording, by the use of equalization suitable to the printing process to be used.

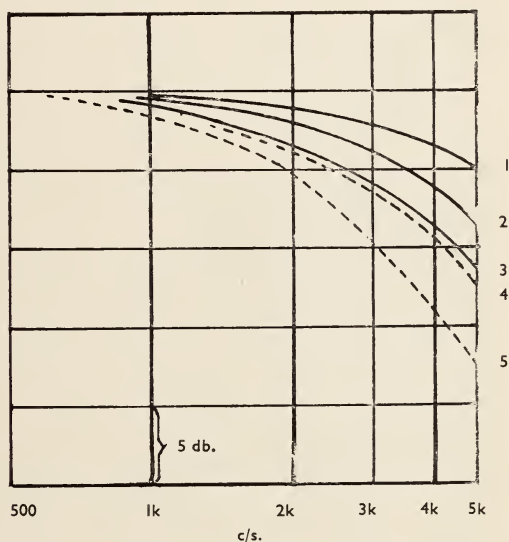


Fig. 1. Curves showing frequency response of sample 16mm. positive tracks.

- (1) Direct positive.
- (2) Contact print.
- (3) Optical reduction.
- (4) Contact print on Kodachrome.
- (5) Optical reduction on Kodachrome.

Next must be considered the recording process itself to discover to what extent this equalization may be carried out.

Recording.

Most 16mm. prints originate either from 35mm. recordings or from 16mm. recordings made in studios which are also used for 35mm. work. It is therefore essential that there should be close agreement between the techniques used in both.

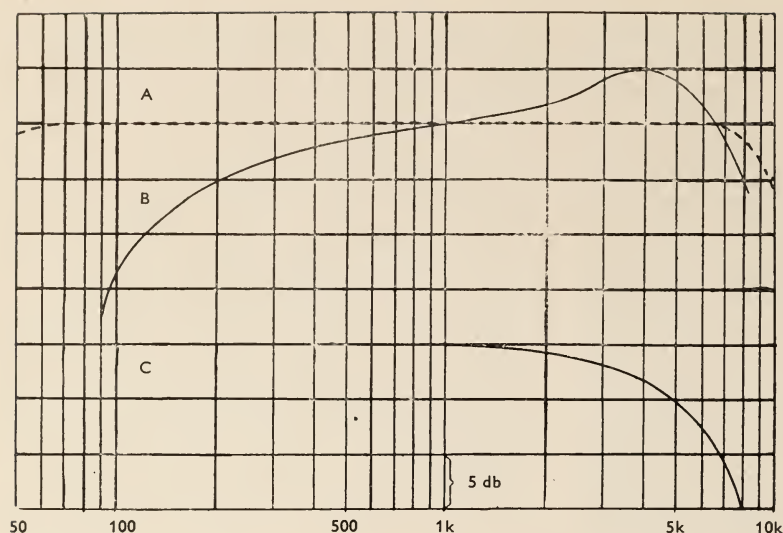


Fig. 2.

Typical recording and reproducing characteristics for 35mm. film.

- (A) Music
- (B) Speech
- (C) 35mm. projection.

In many installations the microphones controls and amplifiers are common to both systems and this is becoming even more usual now that so many studios make their primary recording on magnetic track.

In general, 35mm. recording is made on a constant amplitude basis, that is to say for a constant input signal to the microphone at any frequency the modulation on the 35mm. print will be constant, as shown in the dotted curve of Fig. 2. This response curve has to be modified when recording speech, as shown, in order to correct the apparent preponderance of bass and extreme top when the human voice is reproduced at higher level in the average theatre. This is called "effort" equalization.

When the average reproducer characteristic is taken into account, it will be observed that effort equalization is effective up to about 1 kc/s. From 1 kc/s. to 5 kc/s. the rise in the speech curve is increasingly offset by the theatre characteristic and therefore may be termed "pre-emphasis" or "pre-equalization." Above 5 kc/s. there is a fairly rapid decay, partly to achieve the above mentioned effort effect, and partly to remove distortion products and hiss.

The effective rise at 5 kc/s. compared with 500 c/s. is some 6 db. and it is assumed that the same dialogue characteristic will be used on recordings made for 16mm. release.

It must be remembered that many speech sounds such as sibilants produce relatively high amplitudes in the 3 kc/s. to 5 kc/s. region and this limits the amount of extra equalization which may be given at these frequencies before overloading enforces a general reduction in recording level. However, if a suitable compressor or limiter is used in conjunction with the equalizer, a further 6 db. of equalization is possible up to 5 kc/s. without reducing the general level. This is sufficient for almost complete equalization of contact print losses up to 4 kc/s. or 5 kc/s. and of reduction print losses up to 3 kc/s.

A practical example of how the printer loss equalization may be applied is given in Fig. 3. which shows the frequency characteristics of a complete 35mm. and 16mm. recording equipment now in use. The equipment is used for the transcription of magnetic recordings made according to the characteristics of Fig. 2 for speech and music respectively.

For 35mm. release, curve 3A, is used which gives a negative suitable for 35mm. contact printing.

For 35mm./16mm. optical reduction, the curve 3B is used and the reduction prints from the 35mm. negative are then equalized up to nearly 4 kc/s. beyond which there is a fairly rapid fall off.

For electrical prints on 16mm. film (direct

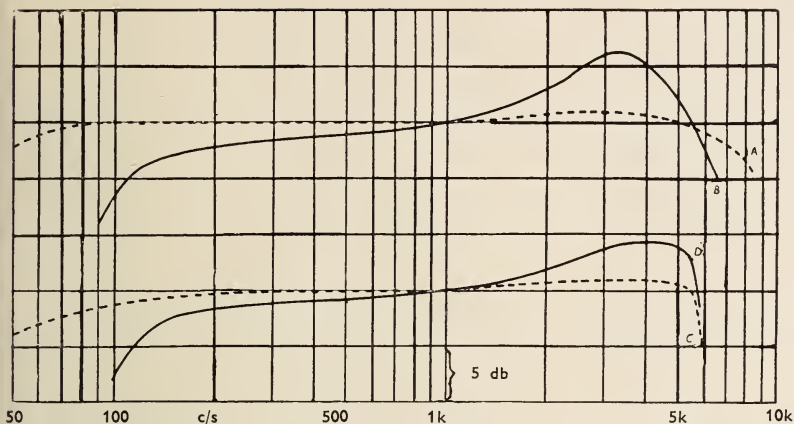


Fig. 3.

Curves showing printer loss equalization used on a typical recording installation.

(A) & (B) 35mm. Recorder

(C) & (D) 16mm. Recorder

positive) curve 3C is used, giving a very gradual fall up to beyond 5 kc/s. which is largely offset by the action of the compressor used.

For 16mm. contact prints, curve 3D is used. On monochrome prints this gives full equalization up to nearly 5 kc/s. while on Kodachrome prints the "roll off" takes place a little earlier.

The equipment does not include provision for recording 35mm. masters intended for optical reduction of Kodachrome, as the degree of equalization necessary for adequate compensation is considered undesirable. The contact printing process from 16mm. track is therefore preferred for high quality work on Kodachrome.

A demonstration recording of music and speech has been made on magnetic track and from this a set of 35mm. and 16mm. masters has been transcribed, each with equalization suitable to the printing process to be used.

The order of demonstration is :—

- (1) Magnetic Record—(curves 2A and 2B).
- (2) 35mm. Print—(curve 3A) normal release print.
- (3) 35mm. Print—(curve 3B) "Compensated Print."
- (4) 16mm. optical reduction—(curve 3B).
- (5) 16mm. direct positive—(curve 3C).
- (6) 16mm. contact print—(curve 3D).
- (7) 16mm. contact print on Kodachrome—(curve 3D).

To enable us to judge the degree of match-

ing achieved between the various prints, they are reproduced on a projector of fixed characteristics to be described in the next section.

The Reproducer.

Most 16mm. projectors are designed for mobile service and this involves the use of auditoria of widely differing characteristics. Excessive reverberation, parasitic echoes, and selective resonances are commonly met with, and their bad effect on sound reproduction is accentuated when noisy listening conditions lead to the loud speaker volume being raised to a higher-than-normal level. A further difficulty arises when requirements of portability dictate the use of a loud speaker of unsuitable directional properties.

Some of these difficulties are dealt with in the recent paper on Presentation and it must be emphasised that the only satisfactory remedy for acoustical faults lies in the application of the appropriate acoustical treatment.

For a variety of reasons, however, the mobile operator is usually unable to apply acoustical correction to each hall used for film presentation, and the only alternative is then to adapt the performance of the sound reproducer to the local conditions so as to minimise the effects of faulty acoustics. This may be achieved by adjusting the frequency response by means of the tone control.

Ideally, the adjustment of frequency response to suit acoustic environment should be the sole function of the tone control. In

practice, however, the tone control is also used to offset the wide discrepancies in frequency response of films currently in circulation. A film programme may include soundtracks of extreme contrasts as to age and technique, such as an optical reduction from a duplicate 35mm. negative of uncertain age on the one hand, and a modern direct recording on the other.

Although under present conditions this secondary function of the tone control is necessary, it cannot be said to be desirable from all points of view.

From the sound recording viewpoint, it provides one more variable factor in the reproducer system and one which is a major hindrance to any effort towards standardization of frequency characteristic. It must be pointed out that a track which requires considerable correction in the reproducer will tend to give excessive background noise or excessive distortion, or both.

In almost every type of 16mm. film show the audience expects and requires the operator to adjust his projector so as to give the most satisfactory sound from the film—even when this entails correcting deficiencies in the soundtrack itself. Therefore the tone control must remain an essential part of the normal projector.

Under these conditions it is not surprising that the sound engineer is not sure what response curve he should aim to achieve. Over a wide range of recording characteristics his work can be made to sound acceptable on some projectors all of the time and on practically all projectors some of the time. What he really wants to know is how he can apply an aural test to ensure that his work will sound acceptable on all except faulty projectors all of the time.

This calls for a viewing theatre of known characteristics—a very difficult thing to specify to the technician working with limited measuring apparatus.

16mm. Viewing Theatre.

A 16mm. viewing theatre for use in conjunction with studios and laboratories for assessing the quality on rushes and release

copies is not an example of presentation. Its function is to reproduce the soundtrack to a standard characteristic, not to glamorise it; to detect faults, not to compensate for them.

In such a theatre it is recommended that:—

- (1) The auditorium be of adequate size, certainly not less than 2,500 cu. ft. in volume.
- (2) Major acoustic faults be eliminated by suitable treatment.
- (3) Reverberation time be adjusted to the recommended value for the auditorium volume.
- (4) Projector noise be reduced to a negligible value by the use of a separate projection room, or by other means.
- (5) The projector, amplifier, and speaker system, be adjusted to give a known frequency response curve.
- (6) The tone controls be then locked at, or at least clearly marked for this setting as “normal.”

The majority of these items may seem logical and indeed they are normal practice in 35mm. work, yet in most 16mm. establishments they are almost completely neglected at present. Item (5), however, needs further explanation.

We have seen in Fig. 2 that the average electrical response curve for 35mm. theatres has a falling high frequency response above 1,000 c/s. which tends to offset the mid-top range of the dialogue equalizer. Since we are reckoning to equalize our printing losses in making 16mm. prints, and are aiming to use the reproducer in acoustical conditions approaching those of a 35mm. theatre, the 16mm. electrical characteristic should not be noticeably different from the 35mm. curve.

This view is substantially in accordance with the tentative recommendations put forward by the S.M.P.T.E.,² which has issued electrical response curves relating to seven types of loud speaker system. These loud speakers are not readily obtainable in this country, but in general they are “two-way” systems which, apart from certain deviations allowed for in the curves, have a substantially uniform forward radiation from 50 c/s. to 8,000 c/s.

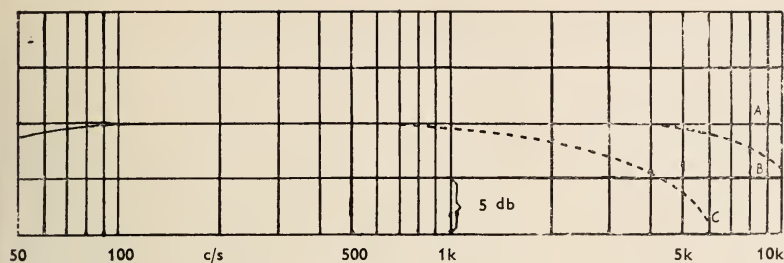


Fig. 4.

Electrical output characteristic of 16mm. test reproducer for:

- (A) Constant voltage into amplifier.
- (B) Constant light modulation on photocell.
- (C) Constant amplitude test film (direct positive).

The electrical response curves of the reproducer used in the demonstration are shown in Fig. 4. The full curve (A) being the amplifier response, the curve (B) the amplifier and photocell response to modulated light source, and the curve (C) the response to a constant amplitude test film.

This latter response curve is very similar to those widely used in 35mm. theatres, and to the general form of the above-mentioned S.M.P.T.E. recommendations and therefore requires that a loud speaker of substantially level frequency response be used.

The loud speaker selected for use incorporates two units mounted co-axially and has a conventional dividing network. The manufacturers laboratory test report shows a response extending from 30 c/s. to 20 kc/s. with a tolerance of ± 5 db. There are no major resonance effects in this range. It is mounted in a cabinet having a solid back and a modified form of horn loading. In accordance with (B), the equipment has no adjustable tone control.

The following features of the projector contribute to its performance as a sound reproducer :

- (a) A 32.5 w. heavy filament exciter lamp ;
- (b) The optical position may be focused for both emulsion positions, each located by positive detent ;
- (c) A synchronous motor drive ;
- (d) Additional hold-back sprocket between sound head sprockets and take up.

Not all these features are common practice on commercial machines at the present time.

Conclusion.

It is submitted that not only can 16mm. prints made by the processes mentioned be matched very closely as regards quality, but they can on suitable equipment produce speech quality which is fully acceptable according to the standards required in 35mm. theatres.

REFERENCES

1. Hind, H.S., "Presentation of 16mm. films." *Brit. Kine.*, **21**, 158, 1952.
2. "Recommendations for 16mm. review rooms." *J. Soc. Mot. Pic. Tel. Eng.*, **56**, 116, 1951.

DISCUSSION

Mr. W. S. BLAND : I have listened to this paper with the greatest interest, and the methods of equalizing for the various printing systems seem very sound. But I cannot agree with Mr. Leever's proposals for a viewing theatre characteristic. The loud speaker used is far too good. The engineer does not want to hear his product reproduced with such a wide frequency range, he is interested in hearing how it will sound on a commercial projector in the field.

THE AUTHOR : The review room is not intended for use by the public but by the technician, and he must hear all that is on the track. He must use it as his "stethoscope" to locate troubles or incipient troubles before they become audible in the field.

Mr. R. H. CRICKS : I have always felt that commercial 16mm. projectors should be provided with separate tone controls for bass and treble and that the bass control should be set to suit auditorium acoustics, while the treble control should be adjusted for each film to suit the quality of the print. Does Mr. Leever support this view ? I would also like to comment on the quality of the demonstration. At last we have heard some really good 16mm. sound.

THE AUTHOR : I believe early models of the Bell and Howell projector had separate bass and treble controls and the use of these in the way suggested is a very good plan under present conditions. It is to be hoped, however, that eventually print quality will

be balanced—as I have demonstrated to-night—to the point where the treble control will be unnecessary.

A MEMBER : The response curves suggest that we cannot expect to get anything above 5,000 c/s. on 16mm. prints. Does Mr. Leever think that good musical reproduction is possible under these conditions ?

THE AUTHOR : I do not suggest that faithful reproduction of music can be achieved with this limitation, but a very satisfying result can be given. We can, of course, exceed the 5 kc/s. limit if we re-record on to the print or use a non-slip printer.

Mr. W. S. BLAND : Does Mr. Leever think that the optical reduction process should be abandoned in favour of 16mm. contact printing ?

THE AUTHOR : If possible, yes, but I do not see that it is possible. In this industry at present more 16mm. prints are produced by the optical reduction process than by all other processes put together. That condition will persist for some time. Much picture material is on 35mm. and both 35mm. and 16mm. prints are required from it.

Mr. M. V. HOARE : I feel that undue attention has been paid to the use of the 35mm. "compensated" negative. In my opinion the trade is becoming increasingly aware of the better prints obtainable with contact printing from a 16mm. sound negative, and this is replacing the use of a compensated 35mm. negative. But this does not get over the problem of getting 16mm. prints from old 35mm. negatives where the cost of a re-recorded sound negative is not justified.

THE AUTHOR : I agree. There is no cheap alternative where old films are concerned. The purchaser either pays for a re-recorded negative and gets good sound or he pays a rock bottom price for an optical reduction from the old negative and gets inferior sound.

A MEMBER : 16mm. sound prints are being used for television transmission and this use will probably increase. Which of the recording characteristics shown to-night is recommended for this purpose ?

THE AUTHOR : I have no practical experience of the suitability of the two alternatives yet, but my Company is committed to two development projects which will include further investigation of this point. On the one hand the desirability of using the same recording for television as for theatrical release prints implies the use of the usual motion picture dialogue characteristic as described in my paper. On the other, we must remember that television sound is primarily intended for reproduction at low volume in domestic surroundings rather than in large auditoria, and for this the more level speech characteristic used by the B.B.C. would seem more logical. In both cases supplementary equalization in accordance with the acoustics of sets must be used and the recommended fixed equalization for the printing process added.

THE CHAIRMAN (Dr. D. WARD) : What method do you recommend for getting the best sound quality on Kodachrome duplicates ?

THE AUTHOR : The method used in the recording demonstrated to-night, that is, a 16mm. direct positive recording using the normal equaliser for speech to which is added the 16mm. printing equalizer and compressor. Duplicates made by contact printing from such a master show a better volume range and a wider frequency response than can be obtained by other processes.

Mr. M. RAYMOND, Jun. (*in proposing vote of thanks*) : At the present time the standardization of print quality is very important, and as the industry develops it will become vital because so many of the smaller cinemas at present operating on 35mm. film will change over to 16mm.

INTERNATIONAL CONFERENCE ON THE SCIENCE AND APPLICATIONS OF PHOTOGRAPHY

The Royal Photographic Society celebrates its Centenary in 1953 and will hold an International Conference on the Science and Applications of Photography from Saturday, September 19, 1953, to Friday, September 25, 1953, in London.

The Conference will cover many aspects of the science, technique and applications of photography, and will be divided into sections dealing with :

- (1) Photographic science (including theory of latent image and development, sensitization, sensitometry, resolving power, granularity, properties of photographic materials).
- (2) Cinematography and Colour Photography.
- (3) Technique and Applications of Photography (including industrial radiography, photomicrography, spectroscopy, aerial photography, photogrammetry, high-speed photography,

nuclear track recording, and other physical, chemical and biological applications ; photocopying ; apparatus, processes, manipulations).

- (4) Photomechanical Processes.
- (5) History, Literature (including abstracting and documentation) and Training in Photography.

All persons taking an interest in photography or its applications are cordially invited to attend the Conference and to submit papers for discussion. Titles and indications of the scope of such papers should be submitted before February 1, 1953. Further details will be sent on application to the Hon. Secretary, R.P.S. Centenary Conference, 16 Princes Gate, London, S.W.7.

THE B.B.C. TELEVISION NEWSREEL

Philip H. Dorté, O.B.E., A.M.I.E.E. (Member) *

Read to a meeting of the Television Division on November 26, 1952.

THERE are, I imagine, few members of this Society who have not seen a comparatively recent edition of Television Newsreel on a television screen, and there is thus little need, I feel, to commence this meeting by projecting one in order that you may better appreciate what I shall be talking about. Perhaps, therefore, a more logical beginning will be the recalling of why and when Television Newsreel first saw the light of day and, after that, an examination of its present aims, the differences between it and its counter-parts in the cinema and in other television broadcasting organizations and, lastly, its probable fate in the foreseeable future.

Pre-War Film Unit.

The very small pre-war Television Film Unit existed primarily for the purpose of renting commercial pictures and of producing the film sequences which, even then, played such an important part in television programmes because without them, a television script has virtually to be confined to the same limitations as a script for the theatre. By this I mean, of course, that given no pre-filming, an exterior scene played in a television studio can be only as convincing as the skill of a scenic artist can make it, and that there is no alternative to an interval if a given artist has to appear in consecutive scenes in different clothes or with different make-up.

Post-War Film Unit.

When plans were being drawn up in early 1946 to re-open the Television Service in the following June, all that was envisaged in respect of a Film Unit was one slightly larger than pre-war but, nevertheless, one which would have the making of these film sequences as its principal aim so far as production was concerned. As to newsreels we assumed,

very wrongly as it turned out, that the cinema newsreels would again be rented to us—and indeed we were hoping that in the post-war era we should be able to televise in rotation all the newsreels instead of just the Gaumont and British Movietone newsreels as in pre-war days. But this was not the shape of things to come. The Television Service re-opened on June 7, without any newsreel, and the only news-films televised during the subsequent 18 months were short films made by the B.B.C. Film Unit on such subjects as the Victory Parade, the Blowing-up of the Fortress of Heligoland, the 1947 Royal Tour of South Africa and the Wedding of the Princess Elizabeth to the Duke of Edinburgh. During that period we continued to press for the cinema reels to be made available to us, but in view of our lack of success we were driven in 1947 to make the decision radically to increase the size and scope of the Film Unit in order to put our own newsreel into production. On January 5, 1948, the first issue of the B.B.C. Television Newsreel went on the air. It was almost twice the length of the cinema newsreel, was to be produced twice a week, and was not very good.

Television Newsreel No. 1 was projected.

For almost exactly two years Television Newsreel continued to be produced on a bi-weekly basis and as the right formula for a Television Newsreel became clearer, more and better equipment was obtained and the production unit began to settle down as an efficient, unified team. The programme (for it is as such that we regard it) improved out of all recognition. The last week of 1950 saw Television Newsreel increased to three editions a week and, as from the first week of June last, we stepped it up still further—this time to five editions. It is its production at this rate that will be discussed.

* Head of Television Films, British Broadcasting Corporation.

Comparison with Commercial Newsreels.

Comparisons with the problems of the commercial cinema newsreels are, of course, inevitable, so let me say right away that from the standpoint of achieving topicality all the cards are stacked in our favour. We do not have to make hundreds of married prints and despatch them by road and rail all over the country; indeed we do not have to make a married print at all—or even an unmarried one, for we record and transmit our sound *via* 35mm. sprocketed magnetic film and, if we are pushed for time, we scan the picture of a given story in negative form and, by reversing phase electrically in the film-scanning or “Telecine” equipment, we ensure that a positive picture will be viewed on the myriad screens that will be receiving it. Apart from the danger of physical damage to what might be valuable negative, the only objection to televising Newsreel in this way is that one loses the often priceless benefit of grading.

And we have another advantage too: the B.B.C. Television Newsreel is normally 1,290 feet in length and thus, at 25 frames per second (which is the speed at which we record and transmit), it has a running time of 13½ minutes. 13½ minutes five times a week gives a weekly screen-time of some 67 minutes, so we can afford to devote the better part of a thousand foot reel to one specific subject if it warrants it. A typical example of this is the first reel of Television Newsreel of September 3 last, when the first story—a preview of the 1952 Air Display at Farnborough—was allocated 950 feet. It was, of course, shot several days before the terrible accident in which John Derry’s aircraft broke up after he had dived through the sound barrier: an interview with Derry was included in the original transmission but was cut out of the film before its repeat.

The Television Newsreel showing the Air Display at Farnborough was then projected.

This illustrates not only the length which we are able to devote to a single subject, but it shows, even if it does not emphasize it, the slow tempo which we deliberately achieve

in both the shooting and editing stages. The reason for a slow tempo is not only because picture-quality on many receivers is such that detail cannot be absorbed if a scene is held for but a few feet, but also because the tempo of live television is slow, and we feel that it is logical to slow down the tempo on film especially shot for television although, of course, not necessarily to the same degree. It illustrates, too, our practice of employing specialist commentators: we do this not so much for the sake of getting a change of voice on a long reel, but rather because we feel that the introduction of a named voice lends authority to a technical subject. Incidentally, these commentators are all members of the B.B.C. Sound Broadcasting staff, specialized in their particular subjects and now just as much at home with visual reporting and all that that implies.

Contents of Newsreel.

What is the policy governing the type of story covered by Television Newsreel and the practical politics of covering it? Here again comparison with the practice of the cinema newsreels would be equally interesting and difficult because Television Newsreel’s basic problem is so very different from the cinema’s. Television Newsreel has the task of trying to do visually and aurally what radio does so well (and so comparatively easily) in sound only and, as television from the angle of the B.B.C.’s audience is but another form of broadcasting, viewers expect to get the same service as do listeners. They do not realise, and why should they, that it takes time to get film negatives to the laboratories, that it takes more time to process it and edit it, to write a commentary and record it; and they take as read the effort involved in televising on a given night the film of an event which happened only a few hours earlier at home or a few days earlier the other side of the world. The business of the Television Newsreel staff is, therefore, to make the reel as topical as practical considerations and human ingenuity can succeed in doing, remembering at the same time that there are many news events which will gain little from

being reported visually, some which it will anyway be impossible to film for any one of several reasons, and others which will rank as neither news nor documentary by the time they can be televised. Sport is much more effective when televised "live." A great deal of sport is so televised so that Television Newsreel should thus only carry sport when it occurs outside the range of the Television Outside Broadcast Units or when an important sports event has been broadcast during the course of a normal working day when the television audience will have been very small. The B.B.C. is essentially and rightly impartial in everything : if Newsreel covers a by-election it must give precisely the same space to the candidates of the main parties, even to the extent of allocating identical footages to those portions of the story devoted respectively to sound and silent coverage of the candidates. It follows that if they cannot be impartial the story cannot be touched at all—as might happen, say, in the case of an industrial dispute if one side is prepared to make a statement before the cameras but the other side is not.

With all that in mind and with the knowledge that although a purely documentary story really has no place in a newsreel (although the invaluable statistics produced by our Audience Research Department show that our viewers like documentary stories in the programme), the pattern becomes clearer: Television Newsreel must, for prestige purposes, carry a quota of stories which the majority of viewers will regard as dull but which, nevertheless, are news and will have a strong minority appeal, for example, International Politics as seen at one of the United Nations or North Atlantic Treaty Organization meetings. Newsreel can carry stories, the details of which are, due to Sound Broadcasting and newspapers, certain to be known to viewers before they see them on their television screens, but which justify space because of the interest of the pictorial background. It can include stories which will appeal mainly to viewers with technical minds—new inventions, novel processes, engineering exhibitions and so on—provided always that these are balanced with stories having a majority

appeal. For the benefit of its female viewers, Newsreel can reproduce at length the latest Paris fashions, but it cannot normally devote much, if any, space to the latest beauty contest. This does not mean that trivial stories can never be shown in Television Newsreel ; it means that where a main story runs on average 300-400 feet, a story, if unimportant yet of passing interest and in good taste, will be found a space of 100 feet or so in a section called "Here and There" which is made up irregularly, as and when there are sufficient stories of this length to justify its production. *A typical "Here and There" was projected.*

Telefilming.

I referred to events occurring during the day of a working week which should be included in Television Newsreel even though they have been made the subject of a live broadcast at the time. We sometimes achieve this coverage by recording the outside broadcast from the tube face and editing the result down to the required length. This process can result in a noticeable drop in quality but it does save sending a film unit as well as an outside broadcast unit to site and, if the site is very far from base, it saves very many hours of time as the actual film cameras are, of course, in London, and the film is thus near to the laboratories, the cutting rooms, the dubbing theatres and the film transmitting equipment. This technique will be developed more and more in the future and I originally intended therefore, to project a specimen here to-night ; but even as I was preparing this paper, we took the decision to go over, in the New Year, to another, quite different, and appreciably better system of telefilming which has just been developed by our Research Department, so I finally decided against showing the results of a process which is now of only academic interest.

Staff camera units shoot at the present time wholly on 35mm. film, and, of the footage which we commission, purchase, or obtain by exchange agreements, the bulk of this is on 35mm. film too. What comes in on 16mm. film at the present time, blow up. The film editors thus work solely on 35mm. film, and the preparation of Television Newsreel



(B.B.C. photograph)

Fig. 1.

The B.B.C. dubbing theatre seen through the window of the mixing room. In the foreground is the mixer desk and disc reproducers for sound effects. The three television monitors are used when sound is to be added to a silent film that is being televised.

for dubbing is identical with that used in preparing cinema newsreels although the treatment is different in that what would be a long-cut of a cinema newsreel story, is the normal cut in Television Newsreel. In dubbing great attention is paid to sound effects, and in so doing we use a large number of discs (the Sound Broadcasting Library of 50,000 sound effects recorded on to 2,500 discs is of course at our disposal). So the normal set-up at a dubbing session involves the mixing of the voices of one, two or three commentators with three film sound-tracks (one natural sound and two music tracks) and effects from no less than four disc turntables. On a normal day dubbing takes place soon after 5 o'clock and, as we record on 35mm. magnetic sound film, there is no further processing to do and, given no last-minute story, the reel is usually ready for transmission at any time from 7 o'clock onwards.

As to the commentaries, I have already referred to our specialist commentators, reporters or correspondents, and I would only add here that all facts and figures are checked, re-checked and then checked again, and that

the type of humour which is so carefully written into cinema-newsreel commentaries is just as carefully removed from ours if, perchance, an over-enthusiastic script-writer has, let us say, over-reached himself; a gag which will make a large cinema audience really rock with laughter can, I assure you, be painfully unfunny to an individual home-television audience of two or three. The B.B.C. Television Newsreel is, to the B.B.C.'s Sound News Programmes, at least a first-cousin (albeit several times removed) and, by long tradition, the B.B.C. goes to great lengths to ensure that its News Programmes preserve dignity as well as accuracy and authority.

The Music Track.

Comparatively few patrons of the cinema attend a screening of every edition of a given Producer's newsreel—and those who do can see and hear only a total of less than 16 minutes a week. On the other hand, statistics show that Television Newsreel is seen by well over 100 per cent of our viewers (in other words many viewers see some editions twice) and as the weekly output of Television Newsreel is now well over an hour, every tune in even

a big music library soon becomes very familiar. We have considered tackling this problem in various ways, including eliminating music entirely as we do in our Science Review which could be regarded as a specialized form of Newsreel. Recently we produced what one might describe as an experimental edition of Television Newsreel with the idea of trying it out on a number of people in a Review Theatre and getting their reactions. It consists of three stories ; on the first one there is no music at all, on the second there is title and playout music but no more, and on the third there is music to the extent that we normally use it—that is when sound effects, natural or dubbed, are inadequate on their own because, for some reason, a story seems to demand music of the right mood to help it “flow.”

The experimental music edition of the Newsreel was then projected.

Problems of Gauge Size.

35mm. versus 16mm. film—is not a future problem for Television Newsreel but one of the moment because many of the television broadcasting organizations being set up overseas are not being equipped to televise 35mm. film, and their film units are thus being provided with 16mm. camera equipment only. This disturbs us because we like to enter into news-film exchange agreements with other television broadcasters. Our own production policy on this is quite straightforward : up to literally a few months ago, there was no 16mm. film scanning equipment which could give picture quality comparable with that of the 35mm. flying-spot equipments which has been at Alexandra Palace for some years now—and in consequence a hasty change-over from 35mm. to 16mm. in so far as B.B.C. film productions were concerned was undesirable. Recently, however, Electrical and Musical Industries, Ltd., have developed a type of 16mm. flying-spot film scanner which gives very good results indeed. The plan now, therefore, is to modify that part of our film transmitting equipment which is normally used for Television Newsreel, so that 35mm. mute, 16mm. mute and 35mm. magnetic sound can be run-up in syn-

chronization and will stay in synchronization for the running time required to transmit 2,000 35mm. feet. It will be in operation some time during 1953, and Television Newsreel will then often be composed of these three separate films, picture changeovers being effected electronically by the operators from a cue-sheet. The blowing up 16mm. film obtained from outside sources will cease, and slowly a change will be made to the sub-standard gauge for silent shooting. With that in mind the B.B.C. are, as a matter of interest, now standardizing for silent coverage on the Eclair Caméflex camera which, as you doubtless know, operates either 35mm. or

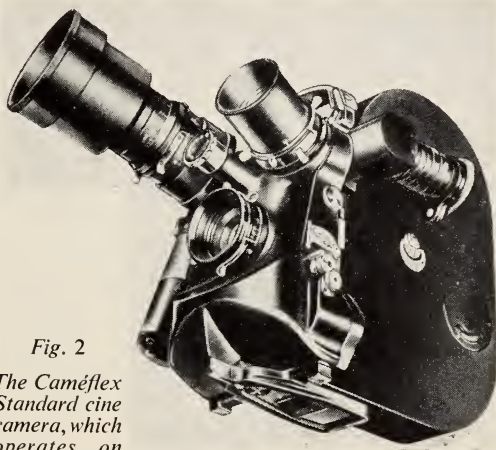


Fig. 2

The Caméflex Standard cine camera, which operates on either 35mm. or 16mm. film according to the type of magazine loaded.

16mm. in accordance with the type of magazine with which it is loaded. For sound coverage, Television Newsreel will continue to use its Vinten/Visatone single-system 35mm. cameras as it is not desired to degrade location sound unnecessarily by recording on the sub-standard gauge.

Possible Future Developments.

What is the future of Television Newsreel ? Television Newsreel heads nearly every popularity poll and it is illogical that it should remain indefinitely at five editions a week when American Television is now carrying two and even three news programmes a day. These news programmes are not wholly film

as is the B.B.C. programme, and I do not believe that our wholly-filmed Television Newsreel and a separate "Sound only" recorded news-bulletin will stay the course for very much longer. If the film component of Television Newsreel is mixed with a live component, be it a studio news-reader, often with "stills," maps, "props" and so on, studio interviews, topical outside broadcasts, or all three, it will gain an immediacy which it now but seldom possesses and it will make it unnecessary for the Television Service to carry, quite independently of Television Newsreel, a recording of the latest sound broadcasting news bulletin. To show what is meant by a live newsreel we shall now

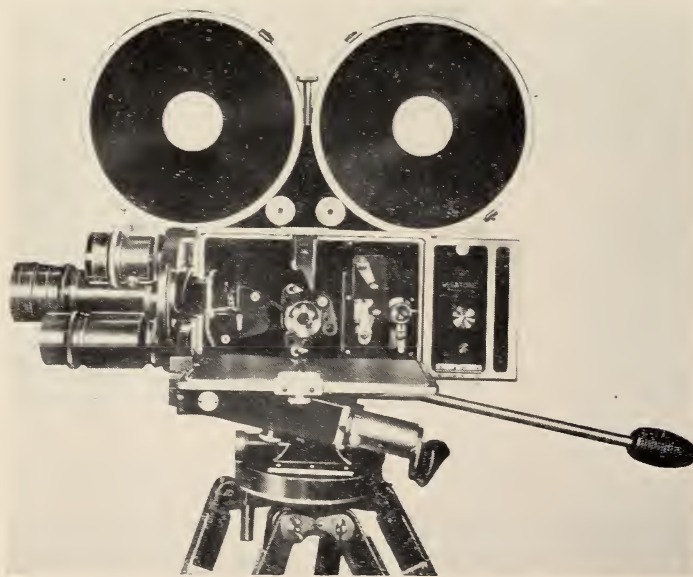


Fig. 3

The Vinten Visatone single-system 35mm. camera used for sound coverage.

project what, for the purpose of this demonstration is, of course, wholly on film. And please do not misunderstand me: I am not saying that this is the shape of the B.B.C. Television news-programme of the future; I am merely saying that it could be—and I would add that it is most unlikely that it will be.

The Experimental Newsreel was then projected.

I will allow myself to prophecy that in due course it will be produced, in whatever the final shape may be, not five times a week or even seven, but fourteen—that is, twice a day.

Present Day Example.

And now from the future back to the present—not to the immediate present because, as this theatre is not equipped with facilities for reproducing 35mm. magnetic sound I cannot project to-night's edition of Television Newsreel as I had originally planned. It is a case therefore, of "the next best thing"—last night's edition of Television Newsreel, designed, of course, not

with an eye to the small but highly technical audience gathered in this theatre to-night, but for the many millions of television viewers to whom it was presumably a typical edition. The sound has been re-recorded on to photographic film but it has not been printed and we shall therefore be running double-headed with positive picture and negative sound. Here then to close, is what, after its repeat transmission next Saturday, will go into our library annotated "Television Newsreel No. 192/52," and which is unlikely to be brought out again before its transfer for safe keeping with all the other Television Newsreels of 1952, to the British Film Institute vaults at Aston Clinton on or

about January 1 next. My excuse for showing it to you is two-fold: firstly to leave this meeting feeling that what is almost the latest edition of Television Newsreel shows some improvement over that first edition projected earlier on. Secondly, this particular edition emphasizes, fortuitously as it happens, that Television Newsreel is used quite unashamedly as a substitute for a television outside broadcast when it is convenient so to use it—as the first story illustrates so well.

The Newsreel was then projected.

NEW EQUIPMENT

As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of news items does not constitute an endorsement.

16mm. POWER OPERATED REWINDER

The equipment manufactured by Burgess, Lane & Company, Block J, Sunleigh Works, Sunleigh Road, Wembley, Middlesex, consists of a portable power-operated 16mm. rewinder, embodying entirely new principles of film drive.

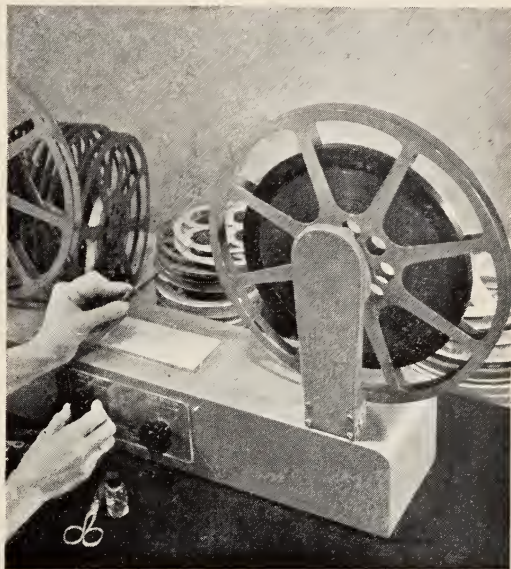
The driving motors and electrical control gear are in a base, measuring 25ins. by 6ins. by 5ins. and geared rewind heads are mounted on either end. An illuminated inspection panel 6ins. by 3ins. is also provided. The weight of the equipment, including 18 feet of high quality 3-core cab tyre cable, is 23lbs.

The unit can be operated at speeds as low as 12 frames per second to enable visual inspection to be carried out, or at 20 ft. per second. Using 400-ft. spools at maximum speeds, the motion of the film can be arrested within 6ins. without imposing extra tension and can be instantly reversed. The unit has a maximum capacity of 2,000 ft.

Each rewinder head is provided with a separate motor so arranged that when rewinding normally from left to right, the right hand motor becomes the master drive and the take-off motor becomes the follower. This latter motor revolves at a slightly lower speed than the take-up motor, the difference in power developed between them resulting in a film tension which is continually variable. No excessive tension can be applied to the film at any time.

Operation is by means of a single centralized

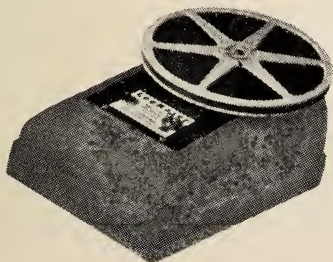
control, having a normal centre-off position. Turning this control slightly to the right starts the rewinding operation on the lowest speeds, further rotation increasing speed. Turning it to the left, repeats this operation in the reverse direction.



(Photograph by the "Film User").

THE LEERASER

The practice of bulk erasure of magnetic recordings is of particular importance to studios and other professional users of magnetic recording. By this means tapes can be erased without the tedious process of running them through a recording machine, thus saving time and avoiding unnecessary wear on both tape and machine.



The "Leeraser" is a compact unit designed for this purpose. It consists of a neat alloy casting containing a magnet system which develops an intense alternating field. Operation is simple. The spool

is placed on the spindle, slowly rotated and then lifted clear, the whole sequence taking only a few seconds and involving no rewinding.

The "Leeraser" can also be used for demagnetizing small articles such as recorder components, editing scissors, screwdrivers, etc. It operates from 220-250v. 50 c/s A.C. mains and consumes less than 2 amps. The price is £7 10s. It is manufactured by Leavers-Rich Equipment Ltd., 37 Wardour Street, London, W.1.

Errata

It is regretted that Figs. 2, 3 and 4 in "The Presentation of 16mm. Films," by Mr. H. S. Hind, appearing in the December, 1952, issue, page 160, were transposed. The above slip will rectify the error. On page 162 of the same article, line 31 of the discussion please read, "rack" and page 161, column 2, line 26, read 10 ft. 6 ins. by 12 ins. by 12 ins.

"International Conference on Cinematograph Standards," 21, 90, line 24, for 0.80 ins. please read 0.080 ins.

THE COUNCIL

Summary of the meeting held on November 5, 1952, at 164 Shaftesbury Avenue, London, W.C.2.

Present : Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), R. J. T. Brown (*Hon. Secretary*), H. S. Hind (*Deputy Vice-President*), G. J. Craig, F. S. Hawkins, T. W. Howard, N. Leever and S. A. Stevens.

In attendance : Miss J. Poynton (*Secretary*).

COMMITTEE REPORTS

Membership Committee.—The following are elected :

David Leonard Deutsch (Student), Group Three, Ltd., Southall Studios, Southall, Middlesex.

John E. Byrd (Associate), 47 Brunswick Gardens, London, W.8.

Edward Flanders Cutlack (Associate), George Humphries & Co. Ltd., 71-77 Whitfield Street, W.1.

Evan Llewelyn Phillips (Member), British Broadcasting Corporation, London, W.1.

William Joseph Yeo (Member), Pan-African Films Ltd., Tudor House, Bree Street, Capetown.

Gerald Myles Wooller-Jennings (Member), Sound-Services, Ltd., 269 Kingston Road, S.W.19.

Leonard Joseph Wilson (Member), Circuits Management Association, Ltd., 5 Bainbridge Street, W.1.

Albert Cecil Hugh (Member), Clarks Cereal Products Ltd., Blackbourne Road, Dagenham, Essex.

Leo Wilkins (Associate), 72 Crummock Gardens, Colindale, N.W.9.

The following is transferred from Associateship to Corporate Membership :

Henry Court, Odeon Cinema, Haverstock Hill, N.W.3.

Report received and adopted.

Education Committee.—Steps are being taken to publish the lectures by Mr. I. B. M. Lomas on Sensitometry.

Report received and adopted.

Television Division.—It is hoped to arrange a further visit to Lime Grove Studios in the Autumn of 1953.

Report received and adopted.

Theatre Division.—Mr. L. W. J. Henton, until recently Heating and Ventilating Engineer at the Circuits Management Association, Ltd., has been awarded the Hon. Membership of the Society.

A Course of Study on the care and maintenance of projection equipment, including instruction on optics, carbons and presentation, will probably be arranged in various provincial centres in the 1953/54 Session.

Report received and adopted.

Standards Committee.—The following terms of reference are approved :

1. To review draft British standards circulated for comment and to prepare comments for transmission to the B.S.I. In this connection to note any comments made by individual members of the Society and to consider whether such individual comments should be endorsed as Society comments or sent forward as the comments of an individual member.
2. To consider what standardization projects would be of advantage to the cinematograph industry and make recommendations to the B.S.I. for the preparation of appropriate standards.
3. To receive periodically reports from the liaison B.S.I. representative on the work of the B.S.I. Committees.

Report received and adopted.

The proceedings then terminated.

Summary of the meeting held on December 3, 1952, at 164 Shaftesbury Avenue, London, W.C.2.

Present : Mr. L. Knopp (*President*), in the Chair, and Messrs. R. J. T. Brown (*Hon. Secretary*), H. S. Hind (*Deputy Vice-President*), A. W. Watkins (*Past President*), G. J. Craig, T. W. Howard, N. Leever, S. A. Stevens and D. Ward.

In attendance : Miss J. Poynton (*Secretary*).

Apologies for absence : Apologies for absence were received from the Vice-President, the Hon. Treasurer and Messrs. F. S. Hawkins and T. M. C. Lance.

Hon. Membership : It is announced with pleasure that Mr. H. L. Griffiths, Secretary to the Cinematograph Committees of the British Standards Institution,

has been awarded the Hon. Membership of the Society.

R.P.S. Centenary : On the 20th January, 1953, the 100th birthday of the Royal Photographic Society of Great Britain, the President, Dr. Knopp, presents the congratulations of the Society in the form of a written address. A silver inkstand will also be presented as a token of the high esteem in which the R.P.S. is held.

Tape Recorder : With much appreciation it is recorded that a Gaumont-Kalee "Teltape" Recorder, Type 799, has been presented to the Society on permanent loan.

COMMITTEE REPORTS

Membership Committee.—The following are elected:

Roy Milbourne Thomas (Associate), 20th Century Fox, Ltd., 31-32 Soho Square, W.1.

Walter Frederick William Harvey (Associate), Exclusive Films, Ltd., Hammer House, War-dour Street, W.1.

Edgar John Conwil Evans (Associate), George Humphries & Co. Ltd., 71-77 Whitfield Street W.1.

Paul Woodrow Hughes (Associate), Odeon Theatre, Worcester.

The following is transferred from Associateship to Corporate Membership :

George William Ashton, British Journal of Photography, 24 Wellington Street, W.C.2.

The death of one Associate was noted with regret.

Report received and adopted.

OBITUARY

Arnold Poulsen (Associate)

Died November 6, 1952

The news has been received with great regret that Arnold Poulsen has died. In 1912, Arnold Poulsen was appointed assistant to Professor P. O. Pedersen at the Technical University in Copenhagen, subsequently obtaining a position with the Siemens laboratories and then with the Great Northern Telegraph Company of Denmark.

Whilst still a student he was connected with Axel Petersen and, from 1918 onwards, they together developed a system for recording and reproducing sound photographically, which later became known as the Petersen-Poulsen system.

In 1925 Arnold Poulsen and his co-inventor introduced their sound film system into other countries. In November of that year, under the auspices of the Gaumont Company, they founded British Acoustic Films, Limited, which company still uses the Petersen-Poulsen sound system.

O. K. KOLB.

SOCIETY DINNER

It has been arranged to hold the Society Dinner and Dance on **Tuesday, April 14, 1953**, at the Savoy Hotel.

It will be recalled that the proposed dinner for 1952 was abandoned because of the death of H.M. The King. This year, being Coronation Year, it is hoped that full support will be directed both from individual members, and the industry in general, towards making

1953 Convention.—It is hoped to include an informal luncheon in the programme for the 1953 Convention and also the showing of a first feature film.

Report received and adopted.

Library Committee.—The great value to members of a comprehensive technical abstract service is acknowledged and consideration is being given to approaching organisations likely to be interested to find out the financial support for such a project.

Report received and adopted.

International Relations.—Of interest to technicians in different parts of the world is the question of transporting and storing film when on location. A specially constituted *ad hoc* Committee is to co-ordinate the problems which exist and endeavour to find methods of overcoming them.

Report received and adopted.

16mm. Film Division.—It is decided to publish the Investigation Reports individually and in the order of their completion. The report on Presentation will be the first in the series.

Report received and adopted.

The proceedings then terminated.

COURSES OF STUDY

TELEVISION IN THE CINEMA

A Course of Study designed to instruct projectionists and technicians in the principles of Television Broadcasting and Large Screen Television reproduction has been arranged to commence in Liverpool on Tuesday, February 24, 1953. Enrolment forms are obtainable from the Secretary, 164 Shaftesbury Avenue, London, W.C.2.

COLOUR FILM PROCESSING AND COLOUR SENSITOMETRY

It is announced, on the one hand with some regret, and on the other, with some satisfaction, that the number of enrolments for the above course exceed the number of places available. However, the course will be repeated in order to accommodate those who cannot be included in the first session. The second course will commence on February 10, 1953, at 164 Shaftesbury Avenue, W.C.2, and the lectures will take place on Tuesday evenings. Should further members wish to enrol, there will be opportunity for them to do so in the second course. Particulars of names and enrolment fees should be sent to the Secretary as soon as possible.

the B.K.S. Dinner a particularly successful and memorable occasion.

The order forms for tickets will be inserted in the February issue of *BRITISH KINEMATOGRAPHY*, and others will be available on application. In the meantime perhaps those who usually bring parties will give prior thought to the matter in order that the Secretary may learn your wishes as early in March as possible.

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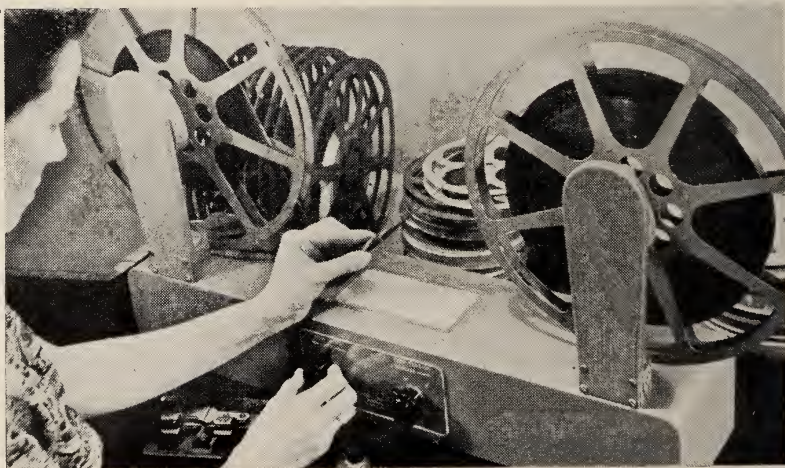
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BRITISH KINEMATOGRAPHY

VOLUME 22 No. 2

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

FEBRUARY, 1953

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CECIL M. HEPWORTH

As we are going to press we have heard with great sorrow of the death of Cecil M. Hepworth, Hon. F.R.P.S. (Hon. Fellow).

An appreciation of this well loved pioneer will appear in our next issue.

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REVIEW OF TECHNICAL DEVELOPMENTS IN 1952

I. COLOUR

AS in other years little of revolutionary importance has taken place in colour motion pictures during 1952. The trend of progress in this field is gradual and it is probable that a year is too short a period for anything novel to become really established or for its importance to be properly assessed. If patent literature is examined without any reference to actual practice it is only too easy to assume that in a very short time many preconceived ideas, which have been widely held, will go by the board. This is a dangerous trap too often fallen into: a fair length of time usually elapses between the patenting of an idea and its commercial use. Many patents which seem excellent enough on paper will not have any practical worth, and indeed may never have been intended for practical use by the patentee.

In the past year a number of patents have been published in Britain for apparatus to handle stripping monopack negative materials, Kodak, Technicolor and Republic all being represented. But this does not mean that such films will shortly be in use even though they have a number of desirable qualities. These films have the great advantage, from the point of view of handling in the studio or on location, that they give three colour separations without the use of the three-strip camera. In other words, apart from their lower speed they are used in similar fashion to black and white materials. But from the point of view of the laboratory they present some problems which are worthy of serious consideration. The difficulty of faultless stripping of the two upper layers on to separate supports, in total darkness, with the maintenance of perfect register would seem to be a hazardous operation when pro-

duction negative, which represents the only concrete asset for some several thousands of pounds per day production costs, is being handled in this way.¹

So far no production has been photographed on stripping tripack material and no print made from such separation negatives has been publicly shown in spite of the fact that an excellent material of this type was described in 1949 by John G. Capstaff of Eastman Kodak² and by now a considerable footage of this film must have been coated. However, in addition to the machine which was described to the S.M.P.T.E. by Capstaff, both Technicolor and Twentieth Century-Fox are reported as having installed during the year machines to handle stripping monopack.

Colour Negative Monopacks

Many manufacturers of sensitized materials, including Ilford, Imperial Chemical Industries, General Aniline (AnSCO) and Gevaert hold patents on colour negative monopacks which use coloured couplers or other integral masking methods. Such aids are necessary to improve the quality of the colour reproduction given by these films and enable duplicate negatives of at least tolerable quality to be made. But so far the only commercial material to appear is Eastman Colour Negative and the associated internegative film.³

The camera film was used quite extensively during the year, principally in the United States, but also by Wessex Film Productions, London Film Productions and Denham Laboratories in this country for tests. In the United States Warner Bros.⁴ have used Eastman Colour Negative for four feature productions during the year, the release

prints in the U.S.A., together with the intermediates and duplicate colour negatives, being made on the companion Eastman materials. In addition these Eastman materials have been used extensively for all stages except the actual release print by Cinecolor Laboratories and Consolidated Film Industries for their Supercinecolor and Trucolor processes.

Two features have been made by M.G.M. using Ansco Color Negative,⁵ the first of these, which was made the previous year and released both in Britain and America in 1952, was "The Wild North"; the second, "Vaquero" is scheduled for release early in 1953. The Ansco material, which so far seems to have been used exclusively by M.G.M., contains no integral masks, but nevertheless gives results of an extremely acceptable quality. In addition to these two complete features some parts of "Plymouth Adventure" were also photographed on Ansco negative although the release prints have been made by Technicolor.

In Britain an extremely complex situation has arisen in the release printing of the films made on integral tripack materials. Supercinecolor releases are made by Cinecolor (Great Britain) Ltd., at Slough, using Cinecolor three-colour processing methods. But since neither the Eastman nor Ansco print material is available other methods have been adopted for release printing from these negatives. Both Warnercolor (Eastman Colour negative) and Trucolor (Eastman Colour negative) release prints are being made by Technicolor at Harmondsworth. The release prints of the first feature in Ansco Color Negative, "The Wild North," were made by Denham Laboratories using both Gevacolor Positive and Ferraniacolor Positive.

In addition to Denham Laboratories two other British laboratories, George Humphries and Kay's are installing processing equipment to handle Eastman and Gevaert monopack material respectively.

Other Colour Negative Monopacks

Ferraniacolor negative is an unusual monopack in that it is so processed that a positive silver mask is produced in addition

to the three layers of negative dye images. Although this system will not give any correction for the undesirable absorptions of the dyes formed in the three layers it will enable the negative to be processed to a higher gamma, thus giving better saturation, whilst the positive mask will reduce the effective contrast of the negative to a normal figure. The mask is generated by redeveloping the silver bromide which is formed by the bleach bath following colour development. The exposure needed to make the halide developable is made to white light and the developer is a simple metol type. The control of the exact density and contrast of this mask is a rather critical procedure and if it is not properly handled the results may be somewhat unsatisfactory.

A short ballet film has been photographed in Ferraniacolor by Group 3 Productions at Southall and a feature film has been made during the year in Italy, called "Toto Color." This process was also used for a stereoscopic short film by Stereo Techniques Ltd.

Beam Splitter Cameras

In spite of the fair number of films made by miscellaneous monopack processes during the year, far and away the greatest bulk of colour motion pictures were made by the Technicolor process using their three-strip cameras and imbibition print process. It seems certain that this will continue to be the case even when monopack materials become more freely available since the print cost per foot of a monopack is inevitably higher, even before any work is done on it, than the cost of finished prints made by an imbibition process.

So far no feature production has been photographed in Britain using Technicolor cameras balanced for incandescent light although a number of films using this technique have been made in Hollywood. The Harmondsworth laboratory has, however, processed one feature which used incandescent technique during the year, "The Golden Coach" which was made in Rome.

A beam splitter camera, designed to run two films only, was used in Spain, the country of its origin, to photograph a feature which

was released in London at the end of December.⁶ This film, "Babes in Baghdad," was printed by Denham Laboratories on Ferrania

three-layer print material although the final print can, of course, only be classified as a two-colour print.

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II. 35mm. CAMERA EQUIPMENT

THE past twelve months have not produced any really notable progress in studio camera equipment, although numerous improvements in accessories have been recorded. Most of the design work on cameras has been in connection with scientific research and instrumentation.

The Cinerama Process

Turning first to the field of entertainment films, a new and highly specialized camera was made for the Cinerama process, in which the projected picture is slightly higher and much wider than normal,—actually it covers a vertical angle of about 60°, and is 146° wide, seen from the normal viewing point. The unusually wide angle of view is achieved by projecting three films from three synchronized projectors, upon a curved screen. The three films, each bearing the image of approximately one-third of the scene, are photographed in a special three lens, three film camera with six perforation pull-downs. For economy it works at only 16 frames per second, the sound being on a separate multi-track magnetic film. Since this scheme requires three separate projection rooms on a level with the centre of the screen, it remains to be seen whether it can ever pass beyond the stage of being a novelty in a few specially adapted kinemas, such as the Broadway Theatre in New York where the initial demonstration was enthusiastically received.¹

A recently described camera heater enables a Mitchell camera to be used on exteriors in the winter without trouble from sluggish running. Two small 6-volt heaters (American car dashboard cigarette lighter type) are installed in the mechanism of the camera, and arranged to warm the vital bearings. A thermostat resting on an internal metal surface controls the actual temperature of the mechanism rather than the contained air.²

The American Motion Picture Research Council has produced a printed Resolution Test Chart (available at small cost) which is simply photographed at a distance in inches equivalent to the focal length of the lens in millimetres. The image of the chart then exactly fills the 35mm. aperture, and resolution figures can be read off directly in lines per mm. This chart should prove particularly useful to studio camera departments, for making comparative tests on various camera lenses.³

A proposed American Standard seeks to achieve agreement on a standard basis for T-stop calibration of motion picture camera lenses. They are to be calibrated photometrically for the illumination at the centre of the field, thereby allowing for variations in light transmission due to the number of glasses and any anti-reflection coating, but not of course for variations due to uneven illumination over the field.⁴

Lenses

A new series of 35mm. camera lenses has been designed to meet military requirements by the Bell & Howell Co., in conjunction with the General Scientific Corp., both of Chicago. A feature of this series, designated Miltar, is that except in the longest foci, the equivalent focal lengths progress in steps of approximately $1.4 \times$, giving an area change of approximately 2 from one lens to the next. The performance is said to be better than previous military lenses, and comparable with the best studio lenses.⁵

Another range of lenses to appear in world markets is the new f/2 Gauss-Tachar series, made by Astro of Berlin to succeed the f/2.3 Pan-Tachar.⁶

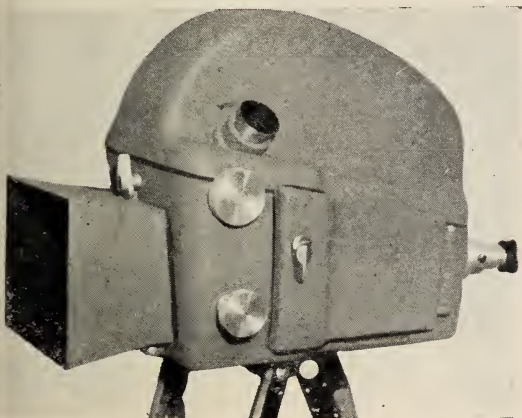


Fig. 1. The lightweight soundproof blimp fitted to the Arriflex.

New Matte Process

Paramount is now reported to be using a matte process known as Vitascope, originally called Simplifilm in France. This system employs an optical foreground matting device before the camera, the matte being a $5\frac{1}{2}$ ins. by $7\frac{1}{2}$ ins. still photograph with cut-outs through which the background action can be seen and photographed. While such a system obviously is of rather limited application, it has the virtue that the combined scene can be photographed at one time on the one film.⁷

A lightweight soundproof blimp for the Arriflex has been introduced by the Kadisch

Camera and Sound Eng. Co. of New York. This blimp has a built-in synchronous motor, external focusing knob, and an extension eyepiece for through-the-lens viewing in the usual way.⁸

The Technicolor cameras have again been put through some unusual paces. When filming "The One Piece Bathing Suit," M.G.M. wanted the camera to dolly forward through a curtain of water from overhead jets. So a waterproof "blimp" was made from transparent Plexiglass to protect the camera, the opening before the lens being protected by compressed air jets which blow the spray away from the lens.⁹

The unusual mobility of camera position now expected particularly in musical pictures is catered for at M.G.M. (Hollywood) by modification of their RO-crane to accept a Technicolor camera, unblimped. This modification includes provision of a rotating base plate for the camera so that both sides of the camera are fully accessible for reloading without removal from the crane. Use of the RO-crane allows a full 360° pan to be made, and the camera can be tilted as far as the vertical lens down position.¹⁰

M.G.M. in Hollywood have also made a camera crane mounted on an adapted Jeep. This crane has all the usual movements and its mobility is found highly convenient on location, where use of a normal crane would be impractical.¹¹

Recent developments in small camera cranes have been principally for television work, although, of course, equally suitable for normal filming. The Houston-Fearless Corp. have made a counterbalanced type small crane,¹² while in Britain W. Vinten Ltd., have introduced a fully motorised Power-operated Run Truck.¹³

Stereoscopic Cinematography

Almost inevitably there is a time lag between the introduction of new methods and their full description in the literature. A case in point is the technical data on the stereo system introduced to the general public at the Festival of Britain Telekinema. A recent comprehensive paper discusses very fully the theoretical basis of stereoscopic

cinematography, and further describes the dual Newman-Sinclair outfit used for many of the Festival films.¹⁴

The method by which two Technicolor cameras were paired up for stereo cinematography has also been described.¹⁵

All this British pioneer work has clearly had a considerable influence on Hollywood, which appears to be progressing along similar lines in the development of its stereo systems. Hollywood has launched into 3-D (American for three dimensional) cinematography with the Natural Vision Corporation's system, which takes two films simultaneously in two standard Mitchell cameras placed with their lenses facing each other. A mirror before each lens reflects the scene into the lens, and enables the usual stereo adjustments to be made. The double camera assembly is mounted in a special blimp and has been used on an Ansco Color production, "Bwana Devil."¹⁶

A Dutch stereo system takes both the L and R eye images on one film, using a camera with a two frame pull-down, two matched lenses one below the other, and mirrors on adjustable mounts to provide the necessary stereo adjustments.¹⁷

High Speed Equipment

Military research accounts for much of the past year's progress in camera equipment. In evaluating the performance of rocket missiles various types of camera are employed. The missiles are often filmed from a distance of several miles, a typical installation being on a tracking telescope with an equivalent focal length of 20ft. Records of azimuth, elevation and time, are also photographed on each 35mm. frame by a suitable addition to the standard type of camera employed.

One camera is fitted to a tracking telescope with an equivalent focal length of from 40 to 80 ft., the installation being located some 40 miles from the launching site.¹⁸

For recording the launching and flight of missiles the U.S. Navy are using batteries of Mitchell High Speed cameras adapted to take medium long focus lenses.¹⁹ In Britain, the Ministry of Supply has exhibited at the

Society of British Aircraft Constructors' Exhibition at Farnborough a short film taken with long focus lenses on Vinten H.S. 300 and Debie High Speed cameras, showing various aspects of rocket research.

While the high speed cameras so far mentioned have employed intermittent movements, progress has also continued on high speed cameras in which the film moves continuously. Acmade Ltd. have now built several production models of their camera, the prototype of which made its appearance just over a year ago. This camera has a maximum speed of 2,000 frames per second, or 4,000 with half frame-height images. Film from a 200-ft. magazine moves continuously on a large sprocket geared to which is a rotating glass block located between the

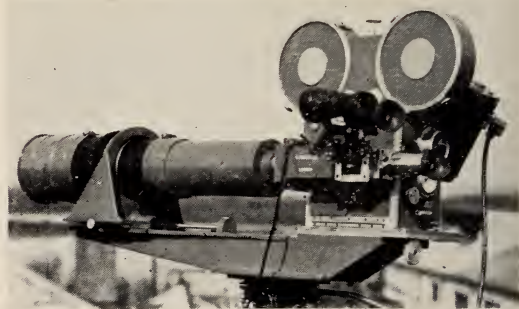


Fig. 2. The Vinten H.S. 300 camera fitted with 36-inch telephoto lens.

lens and the film to provide optical compensation for film movement. An ingenious photo-electric device on the camera triggers the recently described power stroboscope, which flashes once per frame. The flash duration is about 5 micro-seconds, and the energy of the flash is 4 Joules.²⁰

A French ultra-high speed camera gives a speed up to 100,000 frames per second, upon a 75-inch length of film threaded against the inner surface of a drum, around the outside of which is fixed a ring of lenses. This rotating lens drum thus carries the film around with it and provides optical compensation for film movement.²¹

An even more specialized ultra-high speed 35mm. camera is the simple rotating drum model made by the Illinois Institute of Tech-

nology in Chicago. This camera loads with a 48-inch length of film wrapped around the drum, and gives a continuous strip record of

impact loading deformation of rubber-like materials.²²

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III. TELEVISION

IT has been an exciting year for television technicians, partly because of the advances made during the year and partly from anticipation and preparation for the television events during Coronation year. Although this contribution is primarily concerned with television in the cinema, it is essential that we first review developments in the domestic television sphere since this influences considerably the future effects of television in and on the cinema.

Extensions of Television Areas

Just before the New Year, the B.B.C. extended the television service to cover the Lancashire and Yorkshire¹ areas. In March Scotland² was reached and in August, South

Wales, thus completing stage one of the B.B.C. overall television plan. 80 per cent of the population of these Islands can now receive satisfactory television programmes in their homes. Experiments are in hand for a relay to Belfast so that Northern Ireland will shortly be able to receive the London programmes and, it is hoped, participate in the Coronation proceedings. Without doubt this is all a matter of concern to the cinema industry.

Relay from Paris

The transmission of programmes from Paris to England³ in the Summer, 1952, was an outstanding technical achievement because, in addition to the long distance relays

Wright-Patterson
Technical Library
Dayton, Ohio

involved, a change of standard had to be effected half way in the chain where the 819 line picture of the French Service from Paris was converted to the B.B.C.'s 405 line standard, and at this point the picture was also made to synchronize with the British electricity grid system. Although the programme value of these transmissions from Paris was low, it is to be regretted that some of the events televised were not shown in a cinema equipped with large screen projection.

In addition to this ambitious relay the cable and microwave network connecting all the television transmitters in this country was used continuously during the year to transmit sports and other events of national interest from Scotland, from Blackpool, Nottingham, Southend, and Brighton, to all transmitters of the B.B.C.

The versatility and the implications of this instantaneous news reporting⁴ and coverage should be carefully watched by the cinema industry. The rapid and efficient service of the B.B.C. outside broadcast mobile units has been extended further by the introduction of high sensitivity cameras equipped with telephoto and zoom lenses,⁵ thus enabling programmes to be provided with lighting conditions considered inadequate for film cameras.

In addition, the telefilming of programmes which are transmitted at a time of day when most viewers are otherwise occupied has been considerably improved so that events can be re-presented the same evening to the viewers' general advantage. This is a type of service which very soon will have to be given by the cinema industry even if it feels now that it cannot afford to operate its own private television link-ups and news service. It is already being done in America by certain cinema interests.

Improvement in Technical Quality

On the programme side of television, we need not dwell, but in common with the technical side of the B.B.C. studios, there has been a steady improvement in detail during the year. Back-projection has become of

increasing importance to help in the difficult problem of rapid and silent scene changing during the run of a play or during a complicated programme. For example, one such Sunday evening programme, "The Governor," employed 59 back projection shots in addition to 10 studio sets in a programme lasting one hour.

Electronic 'inlay' and 'overlay' have been demonstrated successfully during the year by the B.B.C.⁶ although these facilities have not yet been put into operation on the public service. Their use will enable producers to emulate many more of the tricks so far peculiar to the cinema.

A camera with complete remote control⁷ has been developed this year for use at conferences and similar meetings where the presence of a cameraman might be an embarrassment; for example, during medical diagnosis of nervous patients or during surgical operations.

This camera has remote control of panning and elevation as well as electrical selection of lens on a four lens-turret and a continuously adjustable iris diaphragm.

Theatre Television

On the theatre side there is little to report on new technical advances. The year has been one of consolidation. The Eidophor⁸ demonstration took place in New York during August in conjunction with the C.B.S. colour system.

Large screen projectors have been installed permanently in three cinemas in England and have also been used successfully at the National Trades Exhibition at Birmingham, the Convention in London of the Institution of Electrical Engineers and at the Dental Convention held in the Royal Festival Hall, London.

Projection equipment installed at the Odeon Theatre, Leicester Square, connected to cameras belonging to the C.M.A., was used at the Premiere of 'The Importance of Being Earnest' to present a "live" interview with personalities concerned with the film as well as a mannequin parade—the television programme emanating from a temporary

studio in the theatre. A standard of 625 lines was used as this was a local circuit programme not connected with the B.B.C. television service and only supplied the large screen. The same equipment was also used for a technical convention where speakers were able to show some of their latest equipment in great detail to a large audience. This latter use of television may become a remunerative source of income in off-entertainment hours to a cinema.

It is an indication for the future that the Circuits Management Association, Ltd., has purchased a modern television camera chain which is completely mobile. It will be used in conjunction with the permanent installations of projectors in their cinemas as a local programme source. This leads the way to screening localised events of interest as well as entertainment and opens further new potentials to the cinema industry.

For the Dental Convention the new standard of 625 lines was also employed and the picture was relayed from the surgery-studio in the basement of the Royal Festival Hall over 1,000 ft. of cable to the Telekinema, with most successful results.

Industrial Television

During the year television has branched out into two new fields outside the entertainment industry. Firstly, underwater cameras⁹ have been manufactured by two firms, and have given extremely useful information in diving and rescue operations. Secondly, the

television microscope has been developed as a new tool for lecture purposes and as an aid to further scientific investigations in biology and other fields.

In the social and educational fields, it can be reported that during the year a most successful convention was held under the auspices of the Institution of Electrical Engineers, the subject being "The British Contribution to Television," at which 89 papers were read on various aspects of television. In addition to many demonstrations of new equipment and visits to places of television interest, one session of the conference was presented to a large audience by a television projector specially installed at the Civil Engineers Hall in Westminster. The same evening a popular lecture on television presented interviews with several personalities of the Convention and an excerpt from the B.B.C. evening programme. This demonstration pointed the way to future uses of large screen television.

To keep abreast of the demand of its members to be fully informed on the rapid progress of this new medium, the B.K.S. formed a Television Division during the year and organized a most successful series of lectures on "Television in the Kinema."

Finally, an event which may come as a great surprise to many readers: The Television Society celebrated its 25th Anniversary, having been founded in 1927 immediately after John Logie Baird had first demonstrated his apparatus to the British Association.

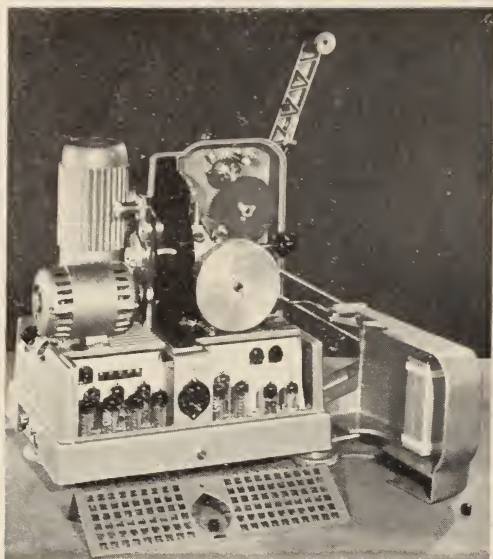
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IV. 16mm. APPARATUS

A NOTABLE contribution to progress in the field of 16mm. cinematography has been the production of the Philips E.L. 5000 projector which, while being costly, provides a very high standard of performance

in both picture and sound quality. A pin-cross intermittent movement is used in place of the almost universal claw movement found in most 16mm. projectors. An asynchronous motor drives the mechanism and the relatively



small number of gears and the low speed blower make the machine very quiet in operation. It is clear that a great deal of careful design and development has gone into the production of both amplifier and mechanism in this excellent apparatus.

A 16mm. Projector

Mention should also be made of the modifications which have been carried out during the past year on the Debie D.16. Redesigning the optical system has greatly increased light output; a three-element condenser is now fitted, all surfaces being coated, and the lens mount has been enlarged to take the new 52.5mm. diameter, f 1.2, 2-inch lens. To offset any loss of definition at this aperture, the gate runners have been slightly curved.

Light output is further improved by alteration of the shutter to two blades—this is an earlier modification which still allows of the use of three blades to reduce flicker when projecting at 16 frames per second.

Debie has announced a new 16mm. professional arc projector with a water-cooled gate which has already been installed at the 5,000 seater Gaumont, Paris. A phenomenal light output is claimed.

Striped Film

The recent introduction commercially of magnetic edge-coating on 16mm. positive stock is opening new vistas to the amateur

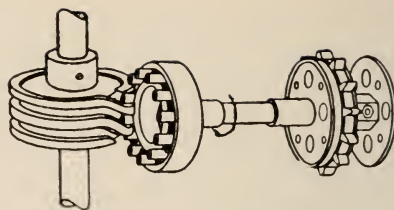


Fig. 1 (left). Side view of the Philips projector with the gear and amplifier covers removed. The flywheel, lamphouse, shutter, motor and inching knob are seen. Fig. 2 (above). The intermittent mechanism.

as well as to the professional. Several projectors handling both photographic and magnetic tracks are now appearing. They are equipped with microphone input to a recording head *via* the projector amplifier to enable commentary, music and effects to be applied by the film-maker directly to the positive print. The edge-coating process is carried out preferably after exposure and development of the film. Owing to the increased frequency range thus obtained, striped film overcomes a serious limitation associated with 16mm. photographic sound, while the higher signal-to-noise ratio is of decided value. Characteristics of the new system are a frequency range of 55 c/s. to 12,000 c/s., a dynamic range of 50db., and a signal of 30db. above noise level.

The American Armed Services, according to a recent report, have used over one million feet of "half-striped" 16mm. film for recording essential information in other languages while still retaining the English version on the photographic portion of the track. Recorders have been developed using separate 16mm. coated stock; a portable unit of this type, manufactured in France, may be coupled on the tripod of any one of several well-known cameras, the complete equipment—camera, recorder and amplifier—being powered by a battery of flash lamp cells. Editing and processing of picture and magnetic track are carried out as for 35mm. procedure.

New Lamp

The production of a new Siemens incandescent projection lamp offers certain advantages. Rated at 230v., 750w., it can be used directly on mains supply, thus eliminating the usual heavy 1.25Kva transformer, and making for ease of transport of projection equipment.

Zoom Lenses

During the past year there have been developed several zoom lenses especially for 16mm. cameras, although lenses of this type have been available for 35mm. photography for a number of years and have found ready application in newsreel work. Essentially the zoom lens enables the field to be smoothly and continuously varied without interruption of the take, producing the impression that the camera is tracking over the distance between the operator and the scene filmed, at the same time retaining perfect focus.

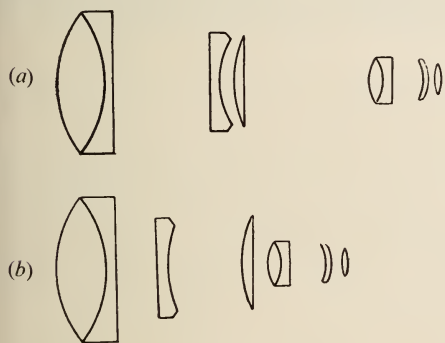


Fig. 3. Cross-section of the Pan-Cinor zoom lens in (a) telephoto position (60mm.), and (b) wide-angle position (20mm.).

An example of this lens now in production, and available in this country, is the Berthiot "Pan-Cinor" which may be fitted to most 16mm. cameras, together with a coupled view-finder which automatically indicates the field of view for any given value of focal length. Operation of the lever fitted to the "Pan-Cinor" gives a follow-focus effect which results in a moving subject being held in focus while the camera keeps pace with the action. Close-ups, medium foreground and general views may be presented in a continuous sequence without alteration of the camera position.

The "Pan-Cinor" has a maximum aperture of $f2.8$ and focal length is variable between 20mm. and 60mm. It consists of a fixed casing containing a mobile lens-mount, the setting of which is controlled by a lever which serves to vary the focal length of the

lens. Initial focussing is carried out by turning the front mount and is subsequently unaffected by variations in the focal length; the diaphragm is also entirely independent of the focal length. All settings can easily be checked at a glance. The lens mount may be fitted with any of the usual attachments, e.g., lens hood, filters, etc. The coupled view-finder is corrected for parallax.

Power Rewinder

Of British manufacture is the recently

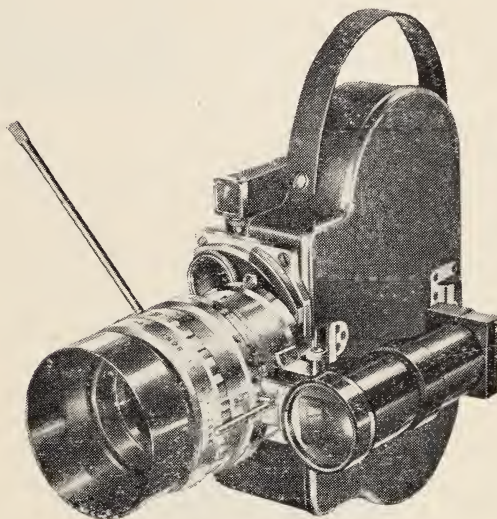
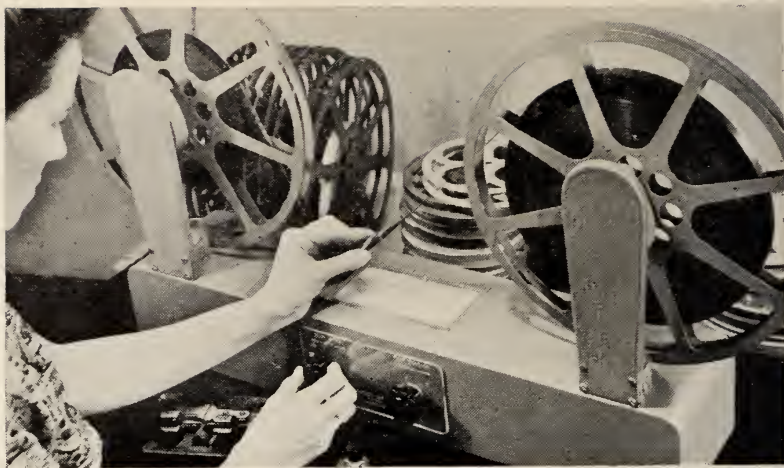


Fig. 4. The Pan-Cinor zoom lens.

introduced Burgess Lane power rewriter. Unlike the large bench power rewinders, this compact hand controlled electric unit occupies little more space than the usual hand driven heads. Each head is connected to a separate electric motor by a spring belt, the motors being inter-connected; both heads are driven and little strain is thus imposed on the film. Tension is controlled by the differential action of the motors which automatically compensate for the variation in diameter on the take-up spool as the film is wound, and braking is evenly applied to the feed spool. A 400-ft. spool can be wound in some 25 seconds, although the speed is variable down to approximately eight frames per second for film examination using the built-in illuminated inspection panel.

Fig. 5

*The Burgess Lane 16mm.
power operated rewinder*



Photograph by the "Film User"

Stereo-Cinematography

At the recent 6th Paris Congress of the International Scientific Film Association, demonstrations were given of two different methods of 16mm. three-dimensional photography—the Cyclostereoscope invented in France by M. Savoye, and the system devel-

Unfortunately this equipment is not in commercial production.

However, now available from the well known firm of Paillard-Bolex in Switzerland comes a simple beam-splitter attachment. The complete equipment for the camera includes a special fixed-focus f 2.8 Kern-Paillard lens, with a focal length of 12.5mm., the beam-splitting attachment, off-set mounting brackets, and a mask, for the viewfinder. All subjects from 4 feet to infinity are in focus. For projection, an f 1.6, 20mm. stereo lens, metallised screen, and polaroid spectacles are used. This equipment is adaptable to most modern projectors.

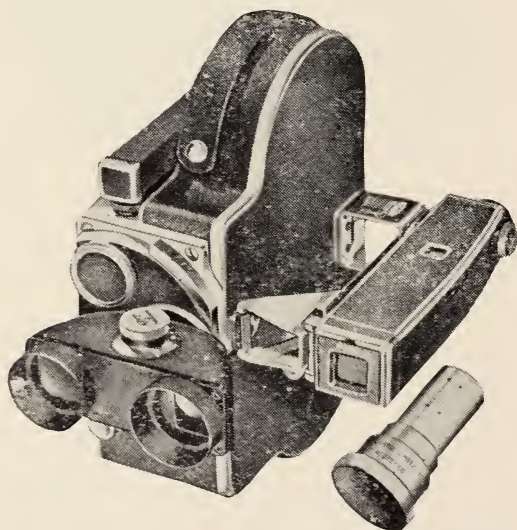


Fig. 6. The Bolex H-16 camera fitted with stereo attachment.

oped by H. Dewhurst of the British Ministry of Supply, T.R.E., Malvern. This latter system uses a simplified beam-splitting attachment similar to that already in use for the production of 35mm. three-dimensional films, and can be used for monochrome or colour.

Variable Shutters

The ability of the 35mm. camera operator effectively to alter his shutter speed gives a wide control over exposure, with a consequent extension in the range of subject lighting, especially when panning scenes over which the lighting level varies. Few 16mm. cameras have been produced with variable shutters, the best known of these being the costly Eastman Kodak Special and the Pathe Model E—"Super 16."

An American company has now undertaken to modify the versatile and reasonably priced Paillard-Bolex H-16, providing the necessary components to convert it to variable shutter operation. It is possible that these facilities may become available in this country.

V. FILM MANUFACTURE AND PROCESSING

DURING 1952, the attention of the British motion picture industry has been concentrated a great deal on two important questions: the potentialities of colour film processes, and the progress of television. These two matters are interrelated, because the threat of competition from television has greatly stimulated interest in the possibilities of an all-colour film programme. It is true that this interest has its source in the U.S.A., where colour television programmes in the home are far too close to commercial reality for anyone in the film business to ignore the prospect. The effect of colour television on cinema attendances if black and white films continue to be shown needs no stressing in order to explain this situation. Moreover, should commercial colour television become a reality, there will be a considerable demand for colour films to include in the programmes.

Influence of Trends in America

The British film industry is strongly influenced by such trends in America because of the large number of American productions which are release printed over here, necessitating the adoption of similar colour print processes; and of course British producers have to consider the effect of the all-colour programme in relation to their export business, where British films may be in direct competition with those made in Hollywood.

So 1952 has been a busy year for the raw stock manufacturers, who have had to grapple with the enormous problem of first making colour film of satisfactory quality at an economic price, and then planning to produce it in sufficient quantity to meet probable demand, while still maintaining an adequate output of black and white films. In Britain there has been much behind-the-scenes activity in this way, but the results will not be seen until the end of 1953 at the earliest. Of course, relatively new colour processes are referred to here, and not the well established Technicolor and Cinecolor processes, which

have been operating to the full capacity of their plants.

The newer colour film processes are all of the integral tripack type, that is, they consist of picture negative and print films each having three separate emulsions coated one above the other on a single support. The best known of these are Eastman Colour, Ferraniacolor and Gevacolor films, all of which have to be imported at the present time. Manufacture of 35mm. integral tripack motion picture film seems unlikely in this country before 1954. Because of currency regulations importation of these films has been limited with a consequent restriction of their use.

Limitations of Integral Tripack

Apart from the problem of supplies, the integral tripack processes were subject to two major limitations as compared with black and white materials. The first was that no duplicating negative film was available so that optical inserts and special effects could not be introduced, and only straight cutting of the original negative was possible. However, this situation has now been rectified and duplicating negative films are obtainable for the respective colour processes. The Ferrania film is of a reversal type enabling duplicate negatives to be made in a single step from the original. The Eastman and Gevaert are similar to the conventional black and white type in that a master positive must first be made, from which the duplicate negative is printed. Since there are three separate emulsions on the original negative, three separate black and white master positives must be prepared, which are then re-combined on the duplicating negative film.

The second limitation concerns the speed of the camera negative film. The best speed obtainable is of the order of B.S.16, or about one-third to one-quarter the speed of a standard black and white negative material. This means that, in studio use, the lighting has to be very bright, and is very hot. A new

Eastman Colour negative film has just been announced, however, which promises to be only a little slower than black and white negative. This film is colour balanced for tungsten illumination, and its speed is conservatively rated at B.S.32, as against 48 for black and white negative under similar conditions.

While undoubtedly there is a wide scope for the use of camera negative materials of the integral tripack type, the possibilities for utilization of the corresponding print films are not so clear. Integral tripack print material is costly to manufacture, so that economically it is unable to compete with the well-established Technicolor process for large scale release printing. Probably, even when available in sufficient quantities, its use will be restricted at first to work requiring a small number of copies. On the other hand, the demand for colour release prints may become so great that cost is looked upon as a secondary factor.

Film Laboratory Equipment

Manufacturers of film laboratory equipment have also devoted much attention to the probable processing machine requirements of those concerned with television and colour film processes. In the former field, Debrie have put on the market the extraordinarily compact "Aiglonne" automatic processing unit for daylight operation. This unit, only 4ft. high by 2ft. 6ins. by 2ft., utilizes solutions at a relatively high temperature (within the range 75° to 115°F.) to achieve results despite such small dimensions. The film is driven through plastic tubes containing the processing solutions and wash waters, all of which

are thermostatically controlled. The makers claim that this ingenious machine is completely revolutionary in design, and indeed it is.

Processing of integral tripack colour films is in some respects similar to that for black and white material, but there are more steps, and thorough washing between certain of them is essential. Thus processing machines for these films are inevitably larger than their black and white equivalents. The situation for manufacturers of such machines is complicated by the fact that processing requirements for the integral tripack colour systems are not identical, so that machines intended for such use must above all be flexible. Debrie have announced a new machine for colour film processing, and flexibility is the basis of the design, which incorporates a large number of separate tanks each with provision for turbulence by means of a pump integral with the tank. Compactness has been achieved by making the tanks small. Processing times can be varied by changing the overall speed of the film through the machine, and also by alteration of loop length in individual tanks. It is claimed that any existing integral tripack film, negative or positive can be processed in the machine. Incidentally, it is of the dual type, consisting of two completely separate processing channels set side by side. Thus the one machine can be arranged for processing of two different films simultaneously, if desired. Vinten also has plans for the modification of the "Spraymaster" for colour film processing. In the proposed arrangement, part of the processing would be by the deep tank method, and the rest by spray.

VI. PRESENTATION

THIS has been a year of consolidation rather than one of any significant advance in the theatre engineering field. On the equipment side, the famous Philips range of motion-picture projectors¹ became available in this country, otherwise the position has been fairly static.

The changeover to safety stock, as far as

new films are concerned, was announced in January as being complete and the circulation of nitrate prints has decreased to a trickle. Difficulties are still being experienced in the handling of the new stock but these are mostly due to inability to adapt techniques to the new characteristics.

The third dimension has gained a firm

footing during the year through the film seasons completed throughout the Country. Stereo-Techniques Polarised system was used and one of the large circuits, A.B.C. carried out trials at the Victoria, Cambridge, in November.

Screen Surrounds

Perhaps the greatest innovation of the year has been the emphasis on modified forms of screen surrounds. When C.M.A. opened their luxurious theatre in Jersey, C.I.,² in June the picture area was masked by a soft grey surround merging into the proscenium opening, and a very striking effect was produced. In September, the RCA Synchro-Screen, well known in America,³ was intro-

equipment and Doncaster and Manchester were among the locations mentioned. In June a public presentation of large screen television took place at the Odeon, Leicester Square, and created great interest in this new medium. In October, it was reported that the Plaza, Regent Street, might be equipped shortly and it was announced in December that the Commodore, Hammersmith, would be equipped with Cintel equipment.

Film Damage

Film damage is still a menace to the renter and exhibitor alike and during the year the Industry Film Damage Advisory Committee has carried out valuable work on this problem behind the scenes. In March the Committee

Fig. 1.

The projection room in the National Film Theatre (late Telekinema).



duced to this Country and an installation was carried out at the Queen's Theatre, Bayswater. The effect of the soft reflections from the screen wings was very pleasing and several further installations have since been carried out.

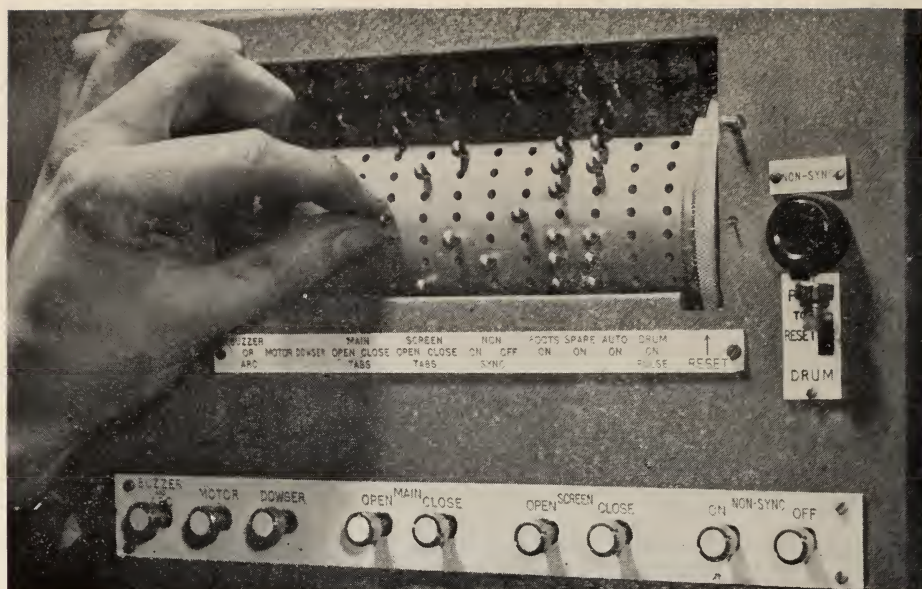
Large Screen Television

Progress has also taken place in the field of large screen television. In January, the C.M.A., Ltd., announced that their chief projectionists would attend a course of study on Television in the Kinema, which had been arranged by the Society and was repeated throughout the country. C.M.A. were later reported to be equipping six theatres with the Cinema Television large screen television

published basic recommendations concerning the correct procedure for splicing safety film and thereby brought to a close the various opinions that tended to retard the progress of safety film use.⁴ Backed by considered opinion from all sections of the industry the work carried out in 1952 should bear fruit in 1953 through a considerable reduction in the amount of film damaged through carelessness or ignorance.

Projectionists' Training

Training for projectionists is still unsettled but one significant step towards a final National Scheme was the completion in July of the B.K.S. National Training Syllabus which laid the foundation for training to be



(Block courtesy "Kinematograph Weekly")

Fig. 2. The timing device on the Essoldomatic.

carried out by Technical Schools throughout the country, and for the first time assured standardized methods of training. The C.M.A. training scheme continued to flourish during the year.

In October the Telekinéma, now the National Film Theatre, re-opened and, equipped with Gaumont-Bell and Howell Model 609 and two B.T.H. Model 301 discharge-lamp projectors, can now project a mixed programme of 16mm. and 35mm. films. The original B.T.H. S/U/P/A 35mm. projection equipment is still in use, having been modified to project at 16 frames per second (with correct masking) as well as at

the normal sound projection speed.

A move towards a semi-automatic operation in 35mm. film projection, was made when the Essoldomatic device was installed under normal working conditions.⁵ With this device the whole programme can be pre-set as regards timing and sequence, thereby taking a lot of work off the shoulders of the projectionist.

Considerable progress has been made in regard to standardization and the Committees of the B.S.I. have been busy under the control of the Cinematograph Industry Committee, and ten new Standards have been approved for publication.

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VII. MAGNETIC RECORDING

THE Society has previously published contributions dealing with the theory of magnetic recording and its application to film production, but it was not until 1952 that this system was adopted by British studios on any considerable scale. There are several reasons for this, the most important being the general policy of restraint in capital expenditure and the lack of suitable equipment, that is, equipment which would satisfy studio requirements.

Thus, while the studios have been slow to adopt the more efficient and economical magnetic system as part of their permanent equipment they have at any rate had ample opportunity to observe and assess the value of new designs as they have become available. In most of the larger studios the choice of equipment seems in effect to be limited to the various types produced by one maker—the manufacturer whose equipment is already installed for photographic recording. Thus studio licensees of both RCA and Western Electric have, with few exceptions, installed magnetic recorders of these same makes respectively for internal use.

Studio Recorders

In general, the studio magnetic recording

equipment for synchronous operation is of two types, the dual purpose (including “conversion” kits) and the single purpose.

Both RCA and W.E. entered the field with dual purpose machines, that is photographic recorders which could be converted into magnetic recorders by the addition of certain extra components. These machines may be used for either photographic or magnetic recording by relatively simple adjustment and switching. While this seems an attractive feature for the small studio as an interim measure, most of the larger studios seem to prefer to confine the use of individual machines to one purpose or the other, so that these convertible recorders tend to be used as single purpose machines.

Existing photographic machines of the RCA PR23 type and the Western Electric RA1231 and RA1251 types may be converted to magnetic operation and this procedure has probably accounted for the majority of sprocket driven magnetic channels put into operation during the year.

Gaumont-Kalee have introduced a studio recorder which, while similar in appearance and mechanical essentials to their photographic machine is nevertheless designed specifically for magnetic service.

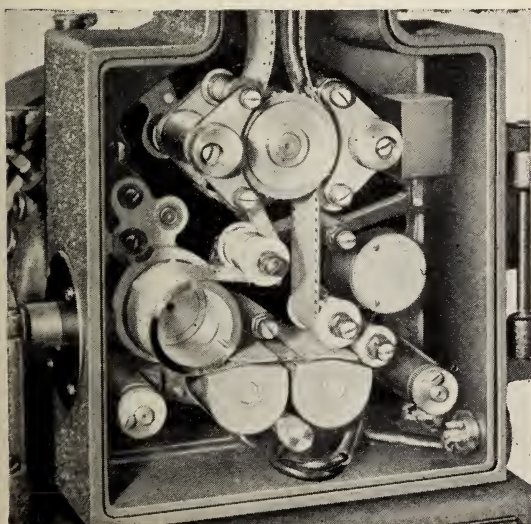


Fig. 1. RCA PR23.

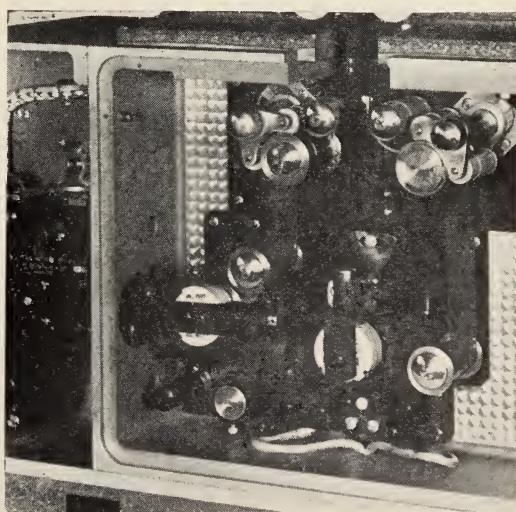


Fig. 2. W.E. RA1231.

In the single-purpose version of the Western Electric RA1251 re-recorder, the optical system is entirely replaced by a magnetic head within the scanning drum which is the preferred position. The machine may be operated as either recorder or reproducer in the usual way.

Both RCA and Western Electric have announced three-track magnetic machines suitable for special service in connection with dubbing and re-recording and here design has been freed from the limitation imposed by light trapping and light proof magazines, and the machines are of the vertical type giving clean layout and good accessibility.

Erase facilities are provided as an optional extra on some of the machines mentioned but on grounds of safety it is usually preferred to employ bulk erasure of recordings by means of separate apparatus.

In general, although adequate performance can be obtained at lower film speeds, the standard speed of 90 ft./min. is adhered to. Likewise no tendency to depart from the standard width of 35mm. film is yet evident in the practice of the major studios, although 17.5mm. and 16mm. versions of most machines are available.

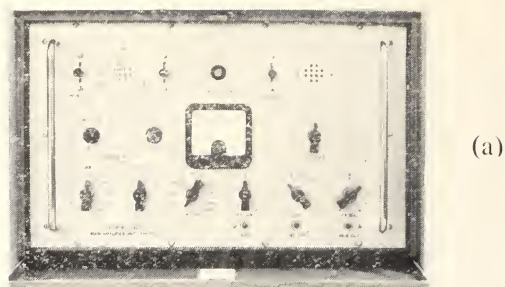
Portable Equipment

The economic and operational advantages of magnetic recording are particularly evident in location service, and some studios have already had several years' experience with portable magnetic apparatus of various types. Two types of apparatus are available, the conventional sprocket driven system and the pulse-synchronized tape system.

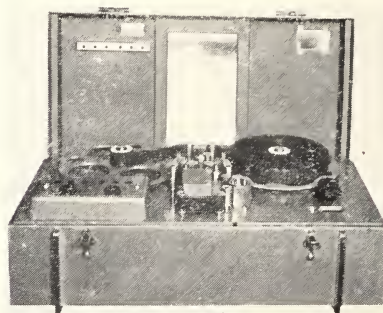
Gaumont-Kalee has also produced a completely new synchronous magnetic recording equipment which, while providing every facility obtained in a static studio equipment, is portable and is capable of the highest standards of performance. It consists basically of the following four units :

Fig. 3 (a) amplifier unit, (b) recorder unit, (c) mixer unit, and (d) power supply unit.

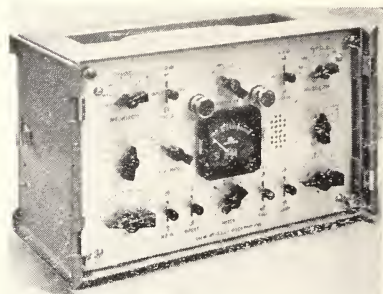
This British equipment is surprisingly compact in view of the comprehensive facil-



(a)



(b)

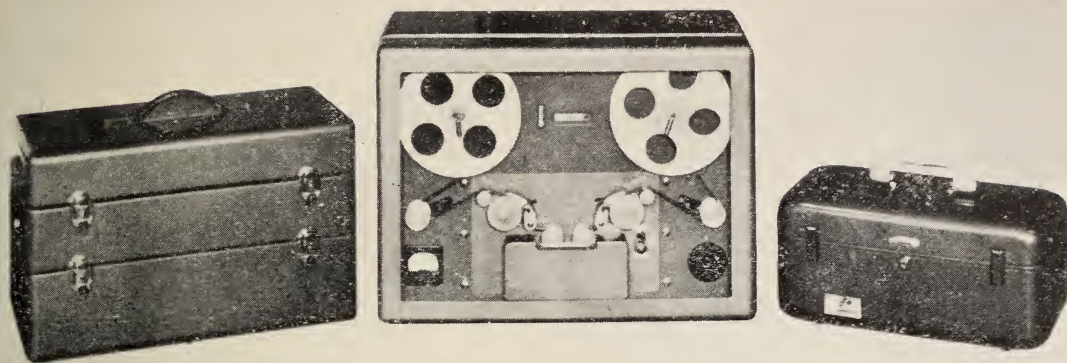


(c)



(d)

Fig. 3. Gaumont-Kalee portable synchronous magnetic recording equipment.



ities offered, which include complete inter-communication and signalling apparatus.

RCA announce two portable equipments, the PM62 and the PM64. Several alternative types of drive motor are available and the mechanism is of the vertical type in each case, the PM62 being adaptable for rack mounting.

The Western Electric series 1000 and 1100 equipments are announced as available for 35mm., 17.5mm., or 16mm. gauge, the standard speed being 90 ft./min.

By reason of its small bulk and low cost, standard $\frac{1}{4}$ in. magnetic tape has always been attractive as a recording medium for portable and general use, and the Leever-Rich Syncropulse recorder enables it to be synchronized accurately to the picture camera. The equipment is arranged in two portable cases and operates from a 12 volt battery. The tape speed is 15 in./sec. This system has been widely used during the past year on mobile service and in the smaller studio installations.

Non-synchronous Equipments

All of the equipments so far mentioned are used on occasion for "wild" recording, but of course simpler apparatus is frequently used for such purposes as sound effects, wild tracks, play back, etc. For ultra portable work, the E.M.I. type L.2 and the Wirek "Reporter" are becoming popular. They are self-powered from internal batteries and will give adequate quality for many purposes where the use of a large machine is not justified or is inconvenient.

For more exacting portable applications the Leever-Rich model C (12v operation) is used or one of the A.C. machines such as the Philips or the E.M.I. B.T.R.2 working from a rotary converter.

The more robust A.C. operated machines are also used in many studios for playback and rehearsal purposes where exact synchronism is not called for.

Recording Film and Tape

Ample supplies of good quality tape have been available from several makers for many

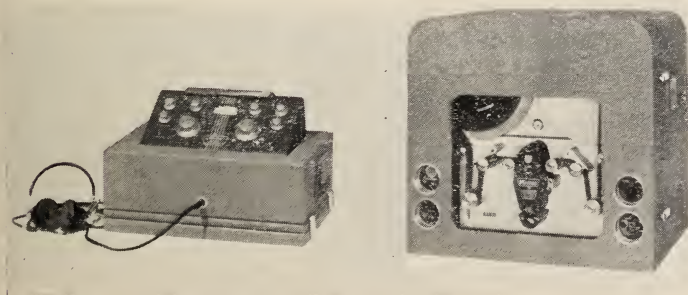


Fig. 4 (above). RCA PM64 portable magnetic recording equipment.

Fig. 5 (left). W.E. 1100 series magnetic recording channel.

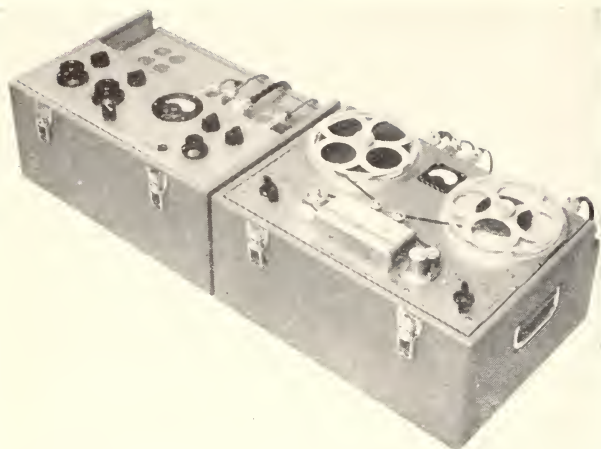


Fig. 6. *The Leever-Rich Syncropulse recorder.*

years but until recently, perforated magnetic film has been more difficult to obtain. 35mm., 17.5mm., and 16mm. perforated film is currently available from Piral and Kodak (both of French manufacture) and Gevaert (Belgian manufacture) while Minnesota Mining Corporation now announce the manufacture of a similar range in this country.

16mm. Striped Film

16mm. projector-recorders using striped film have been demonstrated or announced by RCA, G.B.-Bell Howell, Cinetechnic, Pathé and others, and while there is as yet

no news of these machines coming into general use, there will undoubtedly be much activity in this field in the coming year.

Standards

The British Standards Institution has made steady progress in the important matters of track dimensions, position and running speed. This work comes under technical sub-committees on magnetic film, ACM/6/1 (chairman Dr. O. Kolb) and on tape, ACM/6/2 (chairman R. W. Lowden) and not only is the Society represented on these committees but formal liaison is also maintained through the newly formed Standards Committee of the Society.

At the International Conference on Cinematograph Standards held in New York in June, the Society President, Dr. L. Knopp, attended as a delegate from this country. The track positions for perforated magnetic film came under review and while full international agreement was not attained, valuable interchange of views took place and preliminary agreement on edge position was reached.

Studios

The following production studios are now using synchronous magnetic recording equipment, according to information received up to the end of December, 1952.

<i>Studio</i>	<i>Equipment</i>	<i>System</i>
Admiralty (Portsmouth)	Mobile.	Leever-Rich Syncropulse.
A.B.P.C. (Elstree).	Re-recording channel. (Further mobile channels being installed).	RCA PR.23.
B.B.C. (Alexandra Palace).	Re-recording channel. Mobile channel. Special film scanners and storage equip- ment.	RCA PR.23. G.B.-Kalee, RCA. and E.M.I.
Carlton Hill.	Mobile.	Leever-Rich Syncropulse.
Ealing.	2 mobile equipments. Static.	Leever-Rich Syncropulse. G.B.Kalee " Ferrosonic "

<i>Studio</i>	<i>Equipment</i>	<i>System</i>
Gate (Elstree).	1 re-recording channel. 1 mobile channel. 2 dual purpose reproducers.	W.E. RA.1231. W.E. RA.1231. W.E. RA.1251.
Highbury.	Studio channel (being installed).	Leevers-Rich Syncropulse.
Merton Park.	Mobile.	Leevers-Rich Syncropulse.
M.G.M. British.	Mobile.	Leevers-Rich Syncropulse.
Pathé.	Re-recording.	RCA PR.23.
Pinewood.	Re-recording channel. Mobile. 2 dual purpose reproducers.	W.E. RA.1251. W.E.500 (Modified). W.E. RA.1251.
Southall.	Mobile.	Leevers-Rich Syncropulse.
Wembley.	Mobile.	Leevers-Rich Syncropulse.

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BOOK REVIEWS

Books reviewed may be seen in the Society's Library

THE BRITISH CONTRIBUTION TO TELEVISION. *Proc. I.E.E., Vol. 99, Part IIIA, Nos. 17-20. Institution of Electrical Engineers, Savoy Place, London, W.C.2. pp. 860. No. 17, 20s. Nos. 18-20, 15s. each.*

The convention held at the Institution of Electrical Engineers in 1952 was organised by the Radio Section of that body for the purpose of presenting a comprehensive picture of the development of British Television and the part played by various research teams and individuals in bringing it to its present state of efficiency.

Over 60 papers were presented to an audience of several hundred delegates from this country and overseas in a series of ten sessions, followed by dis-

cussion and visits to places of interest. The formidable task of collating the information in the papers and the contributions from speakers has been admirably carried out by Mr. G. E. Williams, Editor of the *Proceedings of the I.E.E.*, and his staff. The results of their work are now available in four special issues of the Radio Section (Part III) *Proceedings*, Nos. 17-20, which are in the Society's library.

Programme Origination

Of the ten sessions, the one given to Programme Origination is perhaps the most interesting to students of cinematography in relation to television. In this series of 15 papers there is an account of television programme productions problems (Ian Atkins), the

engineering technique of programme origination (D. C. Birkinshaw) and a long paper on Television Recording (W. D. Kemp). The paper by H. E. Holman and W. P. Lucas (E.M.I. Ltd.) on A Continuous-motion System for Televising Motion Picture Films describes the flying-spot continuous motion system and the methods adopted to overcome particular problems. Special facilities include a mechanical filter system, film-shrink compensation and negative film reproduction.

Dr. H. H. Hopkins gave a brief description of his 5 : 1 zoom lens with an account of the aberrations of lens systems and the way in which stable correction of lens errors is achieved. Television studio lighting was dealt with by S. Lewis Johnson, and E. H. Nelson and W. A. Price described special discharge lamps for studios.

One of the most interesting papers was that by T. C. Nuttall (Cinema-Television) on the Development of a High-quality 35mm. Film Scanner. As many members know, this equipment uses a flying-spot cathode-ray tube scanner with continuously moving film and twin optical systems selected by a mechanical shutter. A detailed description is given in this paper of the more important features of the design, including the double folded optical system, the shutter, automatic film shrinkage compensation, servo control of the phase of the driving motor and separately driven take-up spools.

Large Screen Television

Session 7, dealing with Industrial Television, opened with an integrating paper by Dr. R. C. G. Willams (Philips Electrical) on the various non-entertainment uses of the television technique. Large screen television was covered in a paper by E. D. McConnell (Cinema-Television), who described the cathode-ray tube projector developed by that company, and a paper by A. W. Keen (Coventry) dealt with the important problem of synchronization in large screen equipment.

Papers of general interest to the cine engineer were those by A. J. Biggs and E. O. Holland (G.E.C.) on The British Television Receiver ; J. D. Stevenson and F. M. Walker (Mullard) on Cathode-ray Tubes and Valves for Television ; and A. J. Biggs and R. A. Mills (G.E.C.) on the Performance of Receivers in the presence of Interference.

Colour Television

Although colour television in this country is only in the stage of experimental development, there are many basic problems requiring close study before a decision is made on the system to be adopted. The fundamental aspects of colour television are described in an excellent paper by W. N. Sproson, Miss M. Gilbert, and W. West (B.B.C.).

The first part of this paper describes the colorimetric requirements and the methods of scanning, the

second deals with measurement technique and gives some typical results, and the final part deals with effects of flicker, acuity and colour discrimination and describes the basis of certain band-width saving techniques. An accompanying paper by G. T. Winch discusses the objective and subjective aspects of colour rendering.

It is obviously impossible in this short note to mention all the aspects of television which have been covered in the Convention. The papers stand as a record of over fifteen years' intensive work by British television engineers in firms throughout the radio industry and in the B.B.C. and Post Office. The results of their work are seen every day on the receiver screens, which, in spite of the criticisms that have been made of the standards adopted in this country, still show the best and most consistent programmes in the world.

G. PARR.

THEORY OF THE FILM. Béla Balázs. Dennis Dobson Ltd., pp. 291, s.

This book is what its title indicates, an all-embracing study of the theory of film-making. The chapter-framework and the style of writing (the subject matter is broken into many small sections each under its own heading) give the impression of a leisurely, discursive treatment, but as one reads one realises that at its foundations the survey is a thorough and systematic one.

It is doubtful whether Béla Balázs, as the dust jacket to this book claims, was "the first film critic to run a column in a daily paper" thirty years ago ; that honour seems as likely to belong to our own Jympson Harman still happily going strong. Balázs was, however, a prominent continental theorist and critic of the silent cinema in the 'twenties, although not until now has his work appeared, posthumously, in an English translation.

During the last thirty years, however, film writing has developed as much as the film itself ; the best criticism has now become more factual, more specific, better documented than it used to be, and measured by its standards the writing of Balázs has a slightly out-dated air. It tends to be subjective, based on personal theories such as his "physiognomic" theory, and illustrated by examples drawn more or less vaguely from personal recollection (e.g. "Lupu Pieck . . . once made a crime film. In it safe-breakers . . ." etc. ; title and date elude us). To the general reader of 1953, therefore, this book is likely to seem a little old-fashioned and unconvincing. For the student, however, it is one of the indispensable works of theory which must now, belatedly, find room on his shelves beside the works of Eisenstein, Pudovkin, Arnheim, Rotha and Spottiswoode.

ERNEST LINDGREN.

Progress in Standards for the Cinematograph Industry

AT a recent meeting of the Cinematograph Industry Standards Committee of the British Standards Institution, which was attended by Dr. Knopp and five* other representatives of the British Kinematograph Society, Dr. Knopp and Mr. H. L. Griffiths, the United Kingdom delegates to the International Meeting on Cinematograph Standards held in New York in June, formally submitted their report^{1,2} and said that the various Technical Committees of the Institution were actively engaged in reviewing the resolutions of the International Meeting.

The Industry Standards Committee was gratified to note the cordial relationships between the various countries represented at the meeting, and also the considerable amount of work which had been done, resulting in agreements which must inevitably facilitate world trade. The Committee considered that it would be in the interests of the British cinematograph industry for the United Kingdom to participate actively in any future International meetings which might be arranged.

The Industry Standards Committee reviewed, and approved for publication, ten draft British Standards prepared by various Technical Committees on which the B.K.S. is represented. These comprised revisions of the current standards for photo-electric cells and screen luminance, and new standards for studio

spotlights, carbons for projection and stage arcs, 35mm. projector sprockets, and a series of five standards for test films for 35mm. projectors. Draft Standards for 16mm. and 8mm. projector spools were referred back to the Drafting Committee for a further consideration of certain matters of detail.

Particular interest was shown in the draft Standards for studio spotlights and for screen luminance, and appreciation was expressed for the extensive research work which had been carried out by various firms in the industry in the preparation of these two standards.

The new Standard for screen luminance represents a very substantial advance over the 1947 edition. It now specifies not only the limits of luminance at the centre of the screen, but also the permissible diversity between the luminance at the centre and that at the sides of the screen, and it further requires that the specified values shall be obtained when the screen is viewed from any seat in the auditorium. Research has shown that the attainment of a uniform luminance over the whole screen is not, in point of fact, the ideal, and that the most aesthetic presentation results when the luminance at the sides of the screen is between 60 and 75 per cent of the luminance at the centre. This British Standard is now more comprehensive in its requirements than any of the corresponding standards issued by other countries.

The new and revised Standards approved at this meeting will shortly be available from the British Standards Institution and more detailed reviews of them will be included in later issues of this JOURNAL.

* Messrs. R. J. T. Brown, H. S. Hind, R. E. Pulman, S. A. Stevens and I. D. Wratten.

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TELEVISION IN THE KINEMA

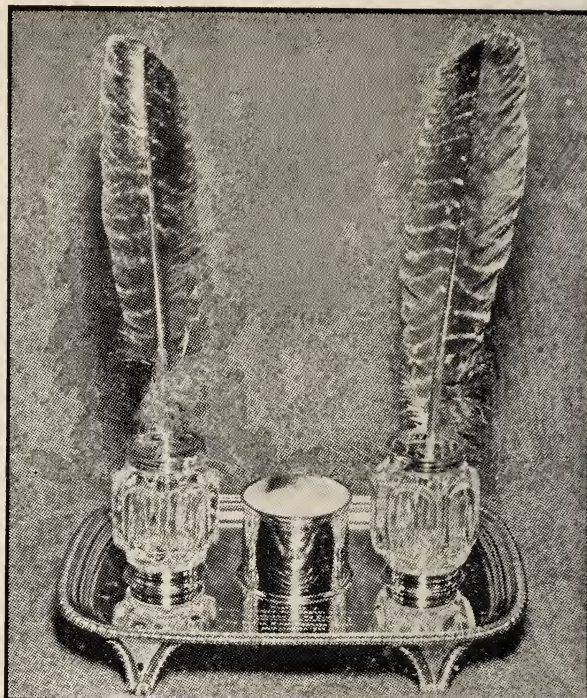
Mr. D. R. Campbell, of the British Broadcasting Corporation, demonstrating apparatus to students attending the first lecture in the course of study on "Television in the Kinema," in Leeds.



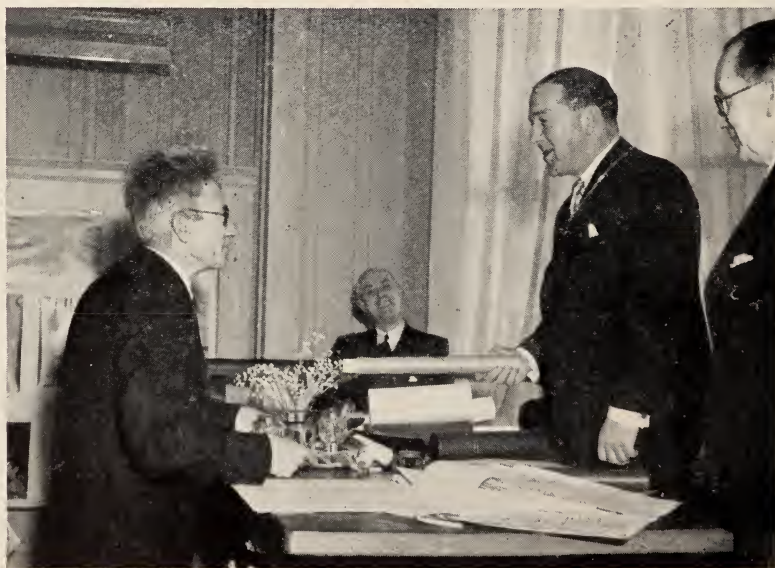
THE ROYAL PHOTOGRAPHIC SOCIETY

Centenary Celebrations

On January 20th, 1953, the 100th anniversary of the foundation of the Royal Photographic Society of Great Britain, the President, Dr. Leslie Knopp, presented to the President of the R.P.S., Mr. I. D. Wratten, F.R.P.S. (Hon Fellow), the congratulations of the British Kinematograph Society in the form of a written address. A Georgian silver inkstand was also presented as a token of the high esteem in which the R.P.S. is held.



(Block by courtesy of the Cinema Press Ltd.)



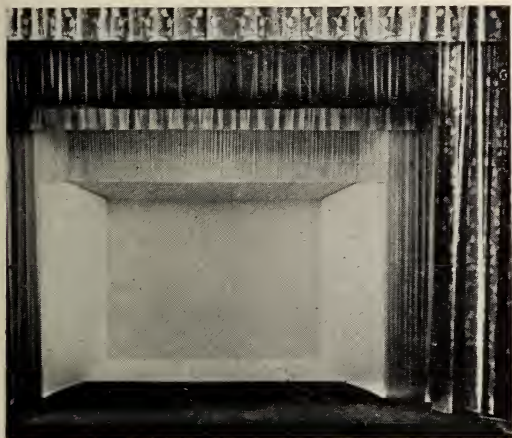
NEW EQUIPMENT

As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of news items does not constitute an endorsement.

THE RCA SYNCHRO-SCREEN

From the earliest days of the cinema, its patrons have been accustomed to the conventional black-masked picture. Since the middle thirties, however, efforts have been made from time to time to devise new and more attractive methods of screen presentation, varying from illuminated surrounds to stereoscopy. For various reasons, either technical, commercial or artistic, none of these methods proved to be a practical success or secured more than passing interest.

Ophthalmologists have long advised that excessive eye fatigue may be caused by conditions where there is an intense central light with inadequate peripheral illumination. It is, of course, well known that the field of human vision extends to approximately 165°



horizontally and approximately 90° vertically in an oval pattern. Of this horizontal field vision is most acute over 40° - 50° and visual acuity diminishes until at the extreme periphery only movement can be distinguished.

In the cinema, the picture subtends an angle of between 20° and 40° at the eye depending upon the position of the viewer in the auditorium. The conventional method of surrounding the bright picture area with black masking is an example of inadequate peripheral illumination.

Among those who gave thought to this problem in relation to the cinema screen was Benjamin Schlanger, a New York cinema architect, who has written a number of articles on the subject. In recent years, after much experimental work he produced the "Synchro-Screen."

The Synchro-Screen, marketed in this country and abroad by RCA Photophone, Ltd., 36 Woodstock

Grove, W.12, is not a revolutionary device, but its use completely eliminates the undesirable black border and furthermore complies very effectively with the two basic requirements of the optical experts :

1. Maximum visibility in the centre of the field of vision, and
2. illumination of the immediate surroundings of this central field so as to produce comfortable and easy viewing without loss of visibility in the central field.

The first requirement is met by using a picture screen of the highest quality modern plastic screen material, and the second is fulfilled by the special features and design of the surrounding wings of the RCA Synchro-Screen.

The screen consists of five parts, the main picture screen, two side wings, a top panel and a bottom panel. The picture screen is of perforated screen material and the adjacent wings and panels are covered with similar material but unperforated. The wings and panels are carefully set up on the stage in a definite relationship to each other and to the projected picture. The design and positioning of these surrounds causes the image of the picture edges to fall on to inclined surfaces so that these edges are out of focus and no abrupt border to the picture area is discernable from the seating area of the theatre. No border line picture jump can be seen. In addition the surrounds of the screen reflect diffused light from the adjacent picture area back towards the audience. This reflection is synchronous in colour and intensity with the picture content, but there is no distraction to the audience since the brightness of the surrounds never approaches the brightness of the picture itself.

The result is an appreciable and dramatic increase in the luminous field of vision. The luminous surround subtends an angle from 90 per cent to 120 per cent to that of the picture area and the picture appears to simulate more closely the viewing of a "live" scene. In this connection it is interesting to note that comments are invariably heard that the use of this screen lends the picture an appearance of depth.

RCA Synchro-Screens are now installed in a considerable number of theatres in U.S.A. and on the Continent as well as in Great Britain, and can be used for all sizes of picture, the largest being in New York where the picture width is thirty feet. Architecturally it provides an attractive stage setting for picture presentation and offers a new atmosphere in the theatre at a modest cost. The use of draw curtains and the flooding of titles with colour can still be used with the screen.



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BRITISH KINEMATOGRAPHY

VOLUME 22 No. 3

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

MARCH, 1953

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THE SOCIETY DINNER

THE arrangements for the Society's Dinner at the Savoy Hotel on Tuesday, April 14, 1953, are progressing and it is hoped that, to avoid disappointment, those wishing to attend will make application for tickets without delay. The Dinner will be held in the Lancaster Room, which many will already know; the maximum number of guests which can

be accommodated is 450.

From the experience of the last Dinner, it seems that there is a preference for a longer period for dancing. Steps have therefore been taken to exclude the cabaret, and it is hoped that Sydney Lipton's Orchestra will provide enough dancing time to satisfy all our guests.

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AERIAL FILMING FOR "THE SOUND BARRIER"

Anthony Squire (Member)

Read to a meeting of the Film Production Division on December 17, 1952

THIS is a film of the lives of test pilots. It opens on a flying sequence in wartime, with a Spitfire. Six more flying sequences follow, with various types of aircraft, and each sequence is a vital part of the plot. They culminate in a series of attempts to fly faster than sound.

Before production on *The Sound Barrier* started it was obvious that the filming of the flying sequences was going to be a major undertaking. A special Aerial Unit was formed which had its own technical crew and production staff and operated independently of the principal unit under David Lean which was shooting the main body of the film. Work was started in the middle of July 1953 and was finished at the end of November. During this time six weeks was spent filming on the ground and three months filming in the air. More than 100 hours were flown in five different types of camera plane, each of which will be described.

THE OPENING SEQUENCE

In the first sequence a pilot suddenly puts a Spitfire into a steep dive and holds it there at far above the permissible maximum speed, just to see what will happen. What actually happens, the sensations experienced in pulling out of the dive, and the way they are analyzed afterwards, form the first main incident in the story—the conquest of the sound barrier.

The Aerial Unit was responsible for all the scenes of the Spitfire flying, the sky backgrounds for the travelling matte shots of the pilot in the cockpit and the eyeline shots of sky and cloud from his viewpoint. By far the most difficult was a long shot of the Spitfire at the end of a steep dive coming down out of a layer of clouds and levelling off below them. This shot occurs at the end of the sequence.

To get material for this sequence five hours were spent in the air shooting the Spitfire and

another four hours shooting nothing but cockpit backgrounds and the pilot's eyelines. The last shot of the Spitfire diving out of the clouds was difficult to shoot because before the start of each take the plane could not be seen. The pilot was radioed his cue for action, the camera was started and the Unit waited for him with only a slight idea of where he might appear. It took a two-hour flight to get one usable shot. In the other takes the Spitfire came down in the wrong position. In order to get this shot the Unit had to fly just beneath the cloud layer where the air is most turbulent and camera operation very difficult.

THE CAMERA PLANES

The camera planes for this sequence were a Viking airliner and a Valetta troop-carrier. The main camera position in the Valetta is on the port side, mid-way between wing and tail. Here, an exit door, 4 ft. wide by 6 ft. high, can be taken off its hinges. In the open doorway is room to mount a Mitchell camera on tall legs and with a 1,000 ft. magazine. There is a good view of a large area of sky with opportunity for panning and tilting even on a wide-angle lens, without having cut-off from the wing or tail. All shots of the Spitfire in flight were taken from this position in the doorway, as were the backgrounds for the cockpit shots.

At first in the Valetta there was difficulty in keeping the horizon level. Every time the aircraft climbed or dived, however gently, or when the speed was increased or decreased, the flying attitude would change slightly, making the horizon tilt. To overcome this, a gimbal head was fixed on the tripod. This had a steel shaft projecting vertically downwards to the bottom of which heavy weights were attached. The clapper boy sat on the floor of the aircraft below the camera, holding the weights and moving



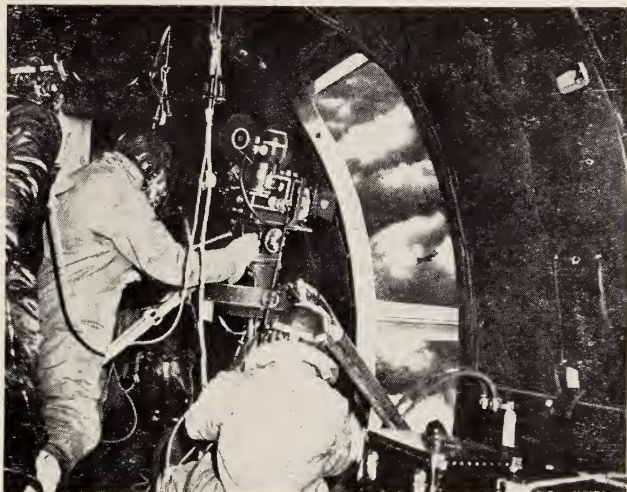
Fig. 1. Plan view of the Valetta, showing the camera viewing angles at the sides and at the nose.

violent manner. The Mitchell camera was also under-cranked. Shooting through the cockpit glass produced no deterioration of quality as it is a perfectly flat straight surface. The camera operator had a reasonable degree of latitude for panning and tilting without getting cut-off from the nose of the aircraft.

The Valetta has a third camera position which is obtained by removing one of the windows in the passenger cabin on the opposite side to the doorway. The camera angle is just as good as from the doorway, but the disadvantage is that the hole through which the lens protrudes is only 18 ins. square, which means that only the camera operator sees what is filmed. The main point of using this position is to vary the flight

Fig. 2.

Camera mounted in the Valetta, showing the paratroop door removed.



them according to instructions from the operator. This may sound primitive, but it worked most efficiently and is recommended to anyone attempting similar work.

The pilot's eyeline shots of sky and clouds were filmed from a position in the nose of the Valetta. The co-pilot's seat was removed and a Mitchell was mounted on a small tripod. The camera had the same view as the pilot. The Valetta is much slower and less manœuvrable than a Spitfire, so that to produce the effect of what a Spitfire pilot sees from his cockpit the Valetta had to be flown in an unorthodox and very

direction.

From a practical point of view the Valetta has many useful features. The cabin has enough room to allow a crew of five to move freely round the camera and there is space to stow spare cameras, magazines, tool-boxes, extra clothing, etc. A large office table for reloading in the air and writing reports was also fitted. At the front of the cabin a few passenger seats were left in position so that the Unit personnel could sit down while in transit, or when the temperature at the open doorway became too cold to be endured for long.

In an aircraft that is not soundproofed it is a mistake to try and converse with other people. One is either not heard or is misunderstood. In the Valetta, intercommunication plugs were installed at many places so that however much people had to move around they could always keep in contact by plugging in headphones wherever they went. For instance, the cameraman might be looking out of the astrodome to ascertain what course should be flown to get the sun and the clouds right, at the same time the director could be watching the Spitfire from the front cockpit, giving the pilot instructions by radio; meanwhile the operator and crew in the open doorway could hear what was going on. I found such a system vital with air-to-air filming because of rapid decisions and changes of plan that have to be made. One member of the camera crew could easily spoil an entire take by being out of touch.

At heights above 12,000 ft. another complication is oxygen. The Valetta has the great advantage that there are oxygen supply points installed as standard equipment at every place where normally there is a seat. It is an easy matter to fit the necessary economizer boxes and plugs at each position where they are likely to be needed. One can walk freely about the aircraft at any altitude plugging in the oxygen pipe wherever one goes.

The Viking

The Viking aircraft is similar to the Valetta but has no paratroop door. The passengers' entrance door, which is used instead, is too far back to give a good shooting angle, being very near the tailplane, and the cabin is so narrow at this point that there is very little room to mount a camera and tripod.

The Tiger Moth

The next aircraft in the picture is the Tiger Moth. This is a small biplane used for giving the first elementary flying lessons to those training to become pilots. It has two open cockpits, the front one occupied by the instructor and the back one by the pupil.

In this sequence the instructor sends his pupil up alone for his first solo flight. The

pupil is not a good pilot and suffers from airsickness. He makes a bumpy and dangerous take-off, an unsteady circuit with bad turns and a bad approach to land. He fails to land properly, bounces, balloons up into the air, stalls and crashes.

The long shot of the aircraft crashing was done with a model and this was the only model shot in the film. All the shots of the Spitfire are live, as are those of the jets. The remaining long-shots of the Tiger Moth were taken quite normally from the ground. The



Fig. 3. A blow-up of the picture taken by the Arriflex camera fitted on the Tiger Moth.

Aerial Unit was responsible only for the close-ups of the pilot in the air and the eyeline shots of what he sees. For all the close-ups the Tiger Moth was being flown by a pilot who sat in the front seat, out of picture. By cutting his control column down to half its proper length, room was made to lash a wooden spar across his knees so that it protruded into the slipstream on either side of him. An Arriflex camera was mounted in positions along the spar according to the lens and angle required for the different close-ups of the pupil, who sat in the back cockpit going through the motions of flying the machine. The Arriflex was driven by a battery inside the fuselage, with a switch fitted on the dashboard of the back cockpit.

The actor was rehearsed on the ground, the plane took off and at the appropriate moment in the air he sprayed his face with a sweat-spray, switched the camera on, acted the shot and then switched the camera off.

To get the eyeline shots, the spar was dismantled and the cameraman flew standing up in the back cockpit with the Arriflex on a small tripod. He was thus able to shoot forwards through the propellor and sideways through the wing-struts. The pilot flew the machine on instruments from the front cockpit, keeping well down inside so as to be out of the picture. Apart from the extra dramatic value of shooting these scenes live, they saved

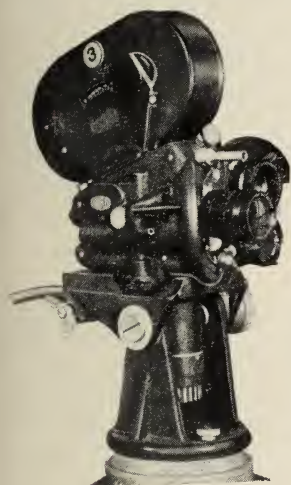


Fig. 4.
*The Arriflex camera,
used in much of the
air-to-air shooting.*

the production money by eliminating the necessity for back projection or travelling matte. It should be added that the Arriflex behaved perfectly throughout this work ; even on the first tests there was no vibration.

THE JET SEQUENCES

Soon after the sequence with the Tiger Moth the story of the picture moves from wartime to peacetime and the first jet aircraft makes its appearance, the Attacker—a single-seat fighter. The prototype Attacker is first seen being put through its paces by a test pilot. There are only four air-to-air shots of the Attacker in flight during this sequence. These were all taken from the starboard window position in the Valetta. This sequence illustrates the contrast between a jet aircraft

and the old fashioned Spitfire and Tiger Moth and contains some shots of the Attacker taken from the ground which are among the most effective in the picture. Like the air-to-air shots these ground-to-air shots all had to be carefully preplanned and rehearsed before they could be got right. The Attacker was travelling so fast that the pilot could never see the camera on the ground. He had to be given a landmark to aim at and a course was mapped out for him to fly on. He was then made to repeat the run until a satisfactory take was obtained.

The next aerial sequence shows, from a Vampire aircraft going on a transit flight from England to Egypt, what the earth looks like when flying at 500 miles per hour. This sounded the easiest sequence to shoot, but it turned out to be the most difficult.

A jet plane was required as camera aircraft. One day there will be such a plane, but at present there is not. The only types of jet that would have been suitable as camera planes were the Comet airliner and the Canberra bomber, but it was impossible to hire one. The only alternative seemed to be a two-seat Meteor trainer, with just the pilot and one cameraman flying, but unfortunately the cockpit proved too small for satisfactory camera operation even with the Arriflex. So a Mosquito of the type used by the Photographic Reconnaissance Squadrons of the R.A.F., was used.

The Mosquito

The Mosquito can fly faster and climb higher than any other propellor-driven aircraft in the world. It is, therefore, the next best thing to a jet. The shots wanted were divided into two categories ; low-level and high-level. Of the low-level shots the two most important were the overtaking of an express train and the crossing of Central London at rooftop height at a great speed.

The express train took several flights to get. The main railway lines from London to the North were covered many times and a large number of expresses was passed, but nearly always something went wrong. Either there was a strong wind and it was too bumpy

flying near the ground to get a steady shot, or the sun went in at the precise moment we were passing the train. The train sometimes stopped because of a signal ; or it would pass through a town, spoiling the effect. On what would have been one of the very best takes, the train went into a tunnel at the critical moment. The scene was shot in the end, but it would have been better if more time could have been spent on it.

The low-level run over Central London is not in the film at all. It was found that at low-level over London, the air is always bumpy, even early on a Sunday morning in mid-summer. In addition to this, the apparent speed could not be boosted enough to produce the impression of 500 miles per hour, even with undercranking. This speed would take



Fig. 5. Side view of the nose of the Mosquito, showing the camera viewing angle.

one from Hampstead Heath to Battersea Power Station in 25 seconds. That was the effect the producer wanted, and it would obviously have been a wonderful shot. I think it could be taken from a jet, and hope that one day it will be shot.

The high-level shots had to be taken from an altitude of 40,000 ft. The most important were : the Straits of Dover, to give the effect of a map ; Paris, to give the effect of a street-plan ; the Alps, seen from 300 miles away ; and a closer view of the Alps when flying directly over them. The shots taken were not too bad, but the quality in most of them is disappointing, at least to anyone who has seen the earth from 40,000 ft. on a clear day and knows what such shots really could look

like. That they fail slightly is due mainly to the limitations of the Mosquito. The aircraft, though larger than the Meteor, was not nearly large enough for comfortable operating. Besides the pilot there was hardly room for two to fly. I sat in the co-pilot's seat with the route maps, spare magazines, filter boxes, a changing bag and



Fig. 6. The view of the Alps seen from 300 miles away.



Fig. 7. Close-view of the Alps shot from 40,000 ft.

two parachutes. The cameraman had to lie full length on the floor and shoot through the perspex nose of the aircraft. On the non-stop flight from Hatfield to the Alps and back we had to remain in these restricted positions for five hours. The perspex nose is not really suitable for cinematography. It is curved, giving flares, and is made of two separate layers of perspex with an air-space

between, giving much distortion. It was found that these defects could be avoided only if the shooting angle was restricted to well below the horizontal. Whenever the horizon was required in the picture, as in the shot of the Alps from a distance, the pilot pulled the aircraft into a steep climb until the nose was high enough to shoot straight ahead. The cameraman had only ten seconds in which to check the set-up and get the shot before the aircraft stalled.

There was not room to mount a studio camera in the Mosquito, in fact there was only just room for the Arriflex. It was not possible to achieve pin-sharp definition from 40,000 ft. through two layers of perspex. Another disadvantage of the Mosquito was that the tanks did not hold enough petrol for a safe margin on the return flight to the Alps. At every target the cameraman was being hastened by the pilot. It was impossible to cruise round, selecting the best set-ups and camera angles.

All the high altitude shots in this sequence were taken on Infra-Red film.

THE FINAL SEQUENCES

The last and most important aerial sequences in the picture show a single prototype jet fighter, the Vickers Supermarine Swift. In the film the Swift is named "Prometheus." The screenplay is deliberately built up through a series of climaxes to prepare for the entry of this aircraft, which is to attempt to break the sound barrier.

The Swift was chosen for the part because in the producer's opinion it was by far the most beautiful and striking of all the jet fighters in existence. Its dart-shaped lines appear completely revolutionary to the average layman and the gleaming metal finish of the prototype is very good photographic material.

A number of the test flights photographed can be said to have revealed to the public for the first time a glimpse of the world in which jet aircraft operate—a world of exploration and discovery on the borders of the stratosphere, where men can exist only in pressurized cabins with oxygen pipes and

pneumatic flying-suits, a world of ever present danger and of breath-taking icy beauty. Vast, empty reaches of sky, snowy wastes of cloud stretching away to an infinitely distant horizon, and the Earth so far below as to seem in another universe—all this David Lean imagined as a frame, with a jet aircraft streaking through the middle of it, diving, pulling out at the cloud-tops, climbing, and diving again in a series of attempts at supersonic flight



Fig. 8. The "Swift" shot from the side door position in the Valetta.

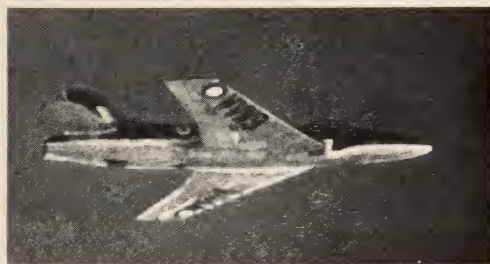


Fig. 9. Close-up view of the "Swift."

He believed it could be filmed, and he was proved right.

Two most important sequences with the "Prometheus" will now be described. In one the pilot is making the first all-out attempt to fly faster than sound. He fails and crashes. As before, the Aerial Unit was responsible for all the flying scenes, as well as the sky backgrounds for the cockpit shots, and the eyeline shots of the sky, clouds and earth as the pilot saw them.

In these two sequences the script stated that the jet must be flying at heights ranging up to 40,000 ft. and at speeds up to 700 miles per hour. But the camera plane, the Valetta, could only climb to 20,000 ft. and could not cruise steadily at more than 200 miles per hour. The illusion of the extra height and speed had to be created, therefore, by photographic means.

To convey height most of the long shots were taken with a wide-angle lens and Infra-Red film was used. Extra care had to be taken in the choice of lighting and weather and it was vital that there never should be more than a few wisps of cloud above, whereas there had always to be a layer of cumulus or stratus below, which appeared, using a wide-angled lens, to be even further below. When shooting air-to-air with the Swift it was arranged that the course being flown was either directly into the sun or directly away from it. The lighting cameraman had only to order small alterations in the course to make the sunlight reflect on the clouds and the jet aircraft exactly as he required. If, having taken off in the camera plane, it was found that the weather and general lighting effect was not suitable, shooting was cancelled, even though the Swift might be waiting to take off. It became second nature to attach just as much importance to the lighting as if exteriors were being shot on the lot. This is stressed because I have noticed that this is not always the practice with aerial filming. Possibly because of the trouble and expense involved in air-to-air shooting there is often a tendency to adopt a rather "snatch - and - grab" approach. The Production Office does not always understand why, if the weather is good on the ground, shooting cannot be done in the air, and this is quite natural. The fact is that aerial shots have to be just as carefully staged and set up, both for lighting and for backgrounds, as do ordinary scenes on the ground.

Most of the shots of the Swift were taken from the open doorway position in the Valetta. A few shots, however, and among them some of the most effective, were taken

from yet another camera aircraft, the Lancaster.

The Lancaster

The Lancaster used had been specially fitted for photographic work. It had three camera positions, one in a perspex turret in the nose, with space to mount a Mitchell on low legs. The angle of view is far wider than from the front cockpit of the Valetta, and one shot was obtained from this nose position that could not have been taken from the Valetta. This is where the Swift enters the picture below the camera and climbs away directly ahead. The great disadvantage of this nose position is that when the perspex gets wet or dirty, unlike the Valetta in which it is possible to reach the outside, it is impossible to clean.



Fig. 10. Plan view of the Lancaster, showing the camera positions.

The second camera position in the Lancaster is the doorway on the starboard side. This position was found to be almost useless because the shooting angle is very restricted. Generally speaking, this plane is far too big and unwieldy for aerial filming. It cannot fly faster or higher than the Valetta, and it is very uncomfortable, being cold, draughty and difficult to move in. However, there is one point in favour of this particular Lancaster, and this is a third camera position in the tail. I have not found such a position in any other type of aircraft. For certain air-to-air shots it proved invaluable. The gun turret has been replaced by an open

camera position with a good field of view, and there is no perspex or glass in the way of the lens. From here shots were taken of the Swift climbing straight towards the camera and leaving at the top of the picture, and also some three-quarter back angles on both sides. The disadvantage of this position is that there is no room to mount a studio camera ; once again the Arriflex was used.

There are a number of technical and practical points which should be mentioned.

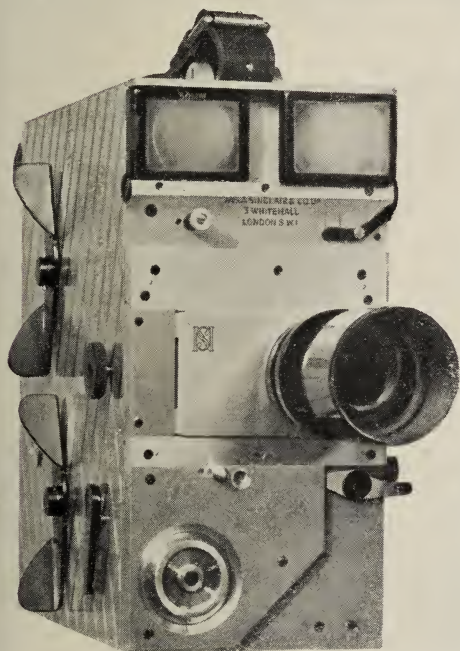


Fig. 11. *The Newman-Sinclair camera, also used in the air-to-air shooting.*

They all apply to the last two sequences.

Camera and Lenses

The Mitchell, the Arriflex and the Newman Sinclair all behaved perfectly in the open doorway of the Valetta at temperatures as low as $-25^{\circ}\text{C}.$, the equivalent of standing on the summit of Mount Everest in a 200-mile an hour gale. The Mitchell was drained of oil, and had an electric heating jacket, though this was not always used. After every flight the cameras had to be stripped and dried

because of condensation. 25mm., 35mm., 40mm., 50mm. and 75mm. lenses were used. They all gave good results, free from distortion and vibration.

The Infra-Red Stock

I.R. film was obtained from America. The emulsion is very fine grained and very slow. The choice of filter can be varied at will according to the effect desired or the amount of haze to be penetrated. The infra-red stock was badly affected by static in the Mitchell, both with and without the electric heating jacket. This seemed to bear out the theory that the build-up of static is due not to cold but to dryness. A careful drill was therefore adopted for keeping the film damp. In spite of this there was still static on the Mitchell. As may be imagined, exhaustive tests in all types of conditions were made, including removing the motor and winding by hand, but finally the Mitchell was abandoned altogether when shooting with infra-red. Neither the Arriflex nor the Newman caused any discernable static.

Curiously enough, the Plus X safety stock, although it got so dry and brittle at high altitudes that it broke in the hand, was never affected by static, even in the Mitchell.

Flying Kit

The inner and outer Sidcot flying suits were found to be very practicable. Thick woollen stockings, flying boots and gloves were also worn. It is essential not to touch very cold metal with bare hands. It is also important to have the right type of helmets, earphones, microphones and oxygen masks. There are many different types of all these articles in use, and it is as well to make sure that the aircraft is fitted for the type chosen.

Hiring of Aircraft

All the camera planes were hired either from the Ministry of Supply or from the makers, such as Vickers and De Havillands, with the Ministry's approval. In theory these planes were being hired on exclusive contract, but it was found in practice that they were being borrowed as and when they could be spared. The Lancaster cost £225 per

flying hour, yet neither it nor its crew were ever fully at our disposal. Often on the very day it was needed, the aircraft had some Ministry work to do. The same applied to the Valetta.

This Ministry Loan Agreement system was the major difficulty encountered, but as it was the only way to get the Ministry of Supply to agree to work, there was no choice. The private charter of aircraft was a possibility, but unfortunately not one private company possessed the particular types of aircraft needed.

The Pilots

It is just as important to have first-class

pilots for aerial filming as it is actors on the studio floor. The director is powerless if the pilot cannot understand and interpret what is wanted. In this respect the Unit was fortunate in working through the Ministry of Supply, because it meant that some of the best pilots in the world were flying the jets and the camera planes. These pilots have been given well-deserved credit titles.

The success of the aerial sequences was obviously due to many factors apart from the camera work. First, to the editing, secondly to the sound effects and dubbing, and thirdly to the high quality of the travelling mattes. There are more than 120 travelling matte shots in the picture.

PINEWOOD STUDIOS

A Review of Recent Technical Developments

R. L. Hoult, A.R.P.S. (Member)*

PINEWOOD Studios maintain a Technical Development Department which was formed immediately after the war and has been in operation ever since. Its activities have covered a wide range of subjects and the results which have been achieved are more evident to those who use these studios than may be apparent to outside workers. Nevertheless, some of these innovations have been carried afield to other studios in Great Britain and are also becoming known in the world at large.

The results of some of the work have already been reported in this JOURNAL by H. McG. Ross.¹⁻³ Much of the technical progress which has been made occurred before the year now under review. The past year has, in common with the rest of the British Film Industry, been devoted largely to consolidation and measures necessary to fight the crisis. That this fight is proving successful is reflected in the limited progress which can be reported even for the past 12 months.

Set Lighting and Effects

Among the least known but most necessary features of a film studio is the power station. A constant and well-regulated supply of direct current from a few to a few thousand amperes is easily taken for granted; it is not so easy to produce in an economical manner. Regulation and load-balancing are the responsibility of the power station staff and the consistency of the cameraman's lighting rests ultimately on alert and efficient operation in the power station. Measures have been introduced so to simplify the labour involved as to result in a standard of power control without precedent in film studios. Reflected as a saving of time and trouble on the floor, this is worth money to the film producer.

We have installed a truly silent artificial wind system. This is obtained from the Plenum installation and has the added advantage that its velocity may be regulated directly from the floor by remote control.

*Technical Research, Pinewood Studios

Another problem which has in the past beset the sound mixer is the noise made by dimmers operated during a take. The conventional dimmer can make an objectionable noise as the operator uses it to follow action; by the construction of a new type of dimmer, this control is now effected in complete silence and with greater ease than before.

The extended use now being made of incandescent lighting for colour film has emphasized the need for a supply of various colour-temperature changing filters for use on studio lamps. A range of four different types of C.T. filters is now manufactured at Pinewood. These filters, two of which are orange and two blue, enable the C.T. of any studio lamp to be altered to match that of any other, with half steps in addition. The control which is thus offered to the cameraman eliminates to a certain extent his dependence on gelatin filters of arbitrary colour and short life, most of which were designed for theatre effects lighting, but which have in the past been the only type available in film studios.

A last refinement is the substitution of a suitable plastic for the paper which by convention is used for diffusion lamps of all types. Paper has the drawbacks of becoming brittle, turning yellow, absorbing light and needing frequent renewal. A matt plastic may be non-inflammable, retain its whiteness and transmit more light than paper. A similar plastic may be made to form the base of a diffusing coloured filter, which, by replacing the conventional coloured gelatin, plus paper, affords a much longer life and transmits a higher proportion of useful light.

Still Photography

An electronic flash installation has been recently introduced into the Stills Studio. Comprising a set of high-power flash tubes controlled from a master panel, this installation enables high-speed action to be photographed for publicity purposes on colour

film. The equipment is manufactured in this country and has proved highly satisfactory in use; it is fully portable and can be wheeled as required to any part of the Studios.

Process Projection

The Studios can claim to provide the highest-quality process projection service in this country, if not in the world. Less emphasis than it deserves has, in the past, been placed on still process projection—possibly because it can only be carried out effectively where adequate equipment is available. Besides having a most modern equipment for this purpose, we have used Ektacolor as a material for making plates for still process projection.

Ektacolor has several outstanding advantages when used in this role compared with other colour materials. Its use will be the subject of a paper to be presented at a forthcoming meeting of the Society.

Arising out of the use of still process projection it is standard practice to cover with still plates all action shots and moving plates whilst on location. In this way, not only is a record made of each set-up, but provision is made for the replaying of any scene (or additional scenes) on the return of the unit to the studio.

Travelling Matte

An alternative process available is the Travelling Matte Process. This process has been in operation for nearly three years now and has been used to date in some thirty feature films. The quality of the results has steadily improved during this period, and particularly during 1952. The latest acquisition is a beam-splitting camera of advanced design which takes 1,000-ft. magazines and, when contained in a blimp of normal dimensions, is completely silent. Together with a more efficient optical system, this new camera is a major contribution to operating economy.

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THE FILM STUDIO

The Development of Equipment and Operation

Baynham Honri, A.R.P.S., F.R.S.A. (Fellow) *

Read to a meeting of the Theatre Division on October 12, 1952

ANCIENT dictionaries tell us that the word "studio" means "the work-room of an artist." The latest pocket dictionaries add the alternatives: "a room in a broadcasting station used for transmission" and, more significantly, "a building or room where film plays are staged."

First Film Studios

Nevertheless, the first film studios were open air affairs with no mechanical appurtenances beyond a space upon which to stand and fix scenery and, in the more elaborate ones, a method of rotating the setting so that it was always facing the sun.

It was the weather which drove the film producer of the nineteen hundreds inside. The scenery suffered from the wind and the rain, and these he put under cover, leaving the wretched cameraman outside. But this was no real hardship, as sunshine was still an essential for his exposures and the glass roof of the studio was fitted with muranese glass, which diffused the sun's rays and softened the shadows. The first studio in England was R. W. Paul's studio stage at Southgate,¹ which was built up above ground level and had trap doors and other devices borrowed from the theatre, together with a trolley on rails, upon which the camera was mounted.² At Brighton, the Williamson glasshouse studio³ was built on similar lines, with a mobile apron which pulled out, upon which foreground pieces could be mounted in front of the camera. This type of studio persisted for many years, both in England and in America, though the stages were built on a rather larger scale; but daylight and sunshine was the main illuminant.

In the United States, large glasshouse type studios, such as the Edison stage in New

Jersey, were built between 1908 and 1914. The Thannhouse Studio, in which several productions were often in progress at the same time, working side by side, was such a studio. In England, the Barker Studio at Ealing was reputed to be one of the best studios of the "glasshouse" era. This stage comprised a steel-framed building glazed with muranese glass. The stage was on the first floor and underneath were the workshops, laboratories, property rooms and so forth. Theatrical trap doors were provided, as in the earlier Paul Studio. The Broadwest Studio at Walthamstow and the Gaumont Studio, Shepherds Bush, were built along the same lines.⁴

In America, sunshine had attracted film producers to California, where vast open air and glass stages were built by Vitagraph, Triangle and others. But the technique of film making was forging ahead and the simple flat daylight results were not good enough. Elaborate arrangements of blinds and diffusers could not overcome the fundamental difficulty of the sun rays changing their direction. Artificial lighting was introduced, at first supplementary to daylight and, later, entirely replacing daylight. Hepworth's Studio at Walton on Thames⁵ was an early British Studio with mixed daylight and artificial lighting, and similar lighting was introduced into many American Studios. The enclosed arc and the mercury vapour tube, giving off highly actinic violet coloured rays were the most popular lights in those early days, and were easily the most efficient with the insensitive orthochromatic film stock then in use.

Use of Artificial Light

Improved results were obtained by cutting out daylight altogether and many of these

* Ealing Studios, Ltd.

glasshouse stages had the muranese glass covered with black paint. By the year 1920 almost every studio was operated wholly with some kind of artificial light. New stages were solidly built, instead of the old flimsy greenhouse structures, and arc lighting became the standard form of illuminant until the introduction of talking pictures in 1928. In that year sound imposed an era of silence upon the studio equipment and personnel. The loudly clicking hand-turned cameras were replaced by the relatively silent high speed cameras (used at first in sound-proof booths) and the noisy arcs were changed for silent incandescent lamps, the use of which was then possible owing to the introduction of red-sensitive panchromatic film stock. It is practically an axiom that the lighting and most other operational equipment of a film studio is dependent upon the type of film stock used, and as this changes, so do various items of equipment become obsolete. Colour film stocks resulted in another change later on⁶, when arcs were introduced in an improved high-intensity and more silent form. Bigger and heavier lighting equipment led to more and more elaborate arrangements for suspending it above the sets, until we arrive at the present-day studio with its huge power station, its refinement of equipment and its multitude of specialist devices, from cobweb machine to artificial snowstorms.

I have so far dealt with the progress of the film studio in a general way, from the time when the studio had an operating staff of a dozen until now, when the number has risen to anything from 150 to 700 or more for a studio turning out first feature films. During the period from about 1914 to the present time, the number of studios in England has steadily decreased at the same time as the scope of the productions has become larger. According to Rachel Low⁷ there were about forty establishments in London and the provinces which could be called studios during the period 1906 to 1914, most of them of the glasshouse type. Some of the modern studios are built on the same sites as the old glasshouse stages, such as Walton-on-Thames, Ealing, Worton Hall, Twicken-

ham and Shepherds Bush. The last three—alas—recently ceased to be film studios. On the other hand, most of the early silent studios⁸, converted from other usages, have long since disappeared or have been recon-verted for other purposes. I mention these because it was not until 1927, when the Cinematograph Films Act was passed, that finance really became available for constructing from the foundations, premises which were specifically designed for film production and were comparable with American installa-

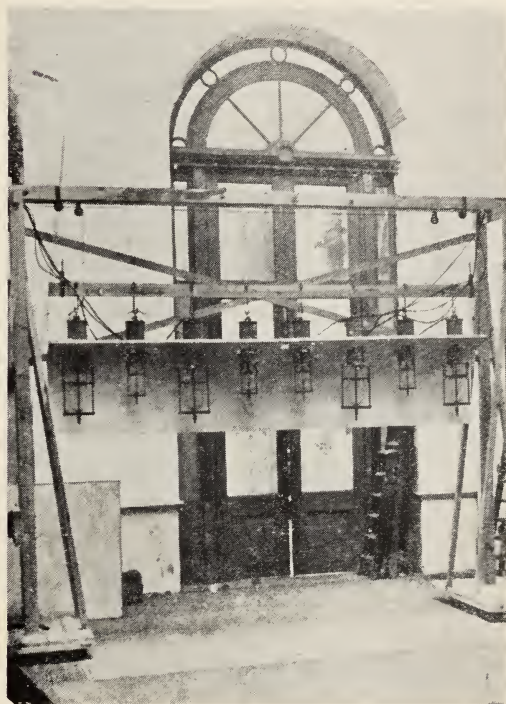


Fig. 1. Part of the "Big Ben" studio at Alexandra Palace (1914)—daylight with supplementary arcs.

tions. Denham, Ealing, Elstree, Pinewood, Shepperton, and other modern plants were then constructed and for the first time the British film could take a leading place in the film diet of the nation and of the world.

Developments in Equipment

In reviewing individual items of equipment and technique used in British film studios from 1900 up to the present time, let us first



Fig. 2. The original Gaumont studio, Lime Grove (1915-17). Daylight was the main light source, until the glass was blacked out in 1918.

consider lighting equipment. Around about 1908, daylight was supplemented by artificial light and the most popular type of studio lamp was the enclosed carbon arc which burned with a long violet-coloured flame. The mercury-vapour type, with similar emphasis on the violet end of the spectrum was also popular. As already mentioned, these lamps were very effective with the orthochromatic film stock of the period, which was, of course, non-sensitive to the red end of the spectrum. The Westminster enclosed arc was almost equal to three open carbon arcs as far as actinic light was concerned. Nevertheless, the Americans persisted with open type arc lamps of various designs,

notably those of Kleigl, Wohl and Wingfield Kerner, on account of their greater controllability and stability, and their improved monochromatic rendering of colours. The Sperry high-intensity carbon arc, known as the "Sunlight" arc, was introduced in 1920 and was considered to be the last word in lighting equipment. It burned 150 amps and had a large parabolic mirror.

A large quantity of these American lamps, including the "Sunlight" arcs, were purchased when the Stoll Studios at Cricklewood were fitted out. But, Sir Oswald Stoll had the idea that by using "Sunlight" arcs in real interiors the high cost of constructing elaborate sets in the studio could be reduced. When he made *Kipps* in 1923, for instance, his film director, Harold Shaw, photographed certain scenes in the Savoy Hotel, but an overloaded cable leading to one of the "Sunlight" arcs became overheated and made a horrible snake-like burn right across an enormous carpet. This cost £900 to replace, which was rather a large slice out of the total budget for the picture of about £5,000, and thereafter Sir Oswald preferred interiors to be shot in his Studios !

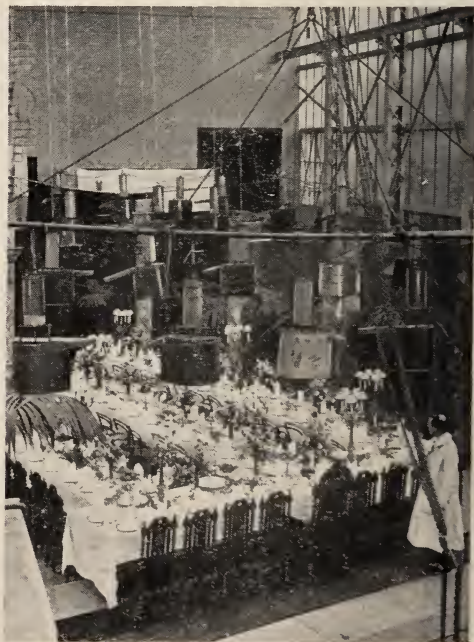


Fig. 3. The interior of the Gaumont Studio.

At the end of the silent period, the larger British studios were operating a very mixed bag of lights. Side by side with a mercury-vapour and Westminster arcs were Kleigl lights, "Sunlight" arcs, open arcs and even incandescent lamps.

In 1929, the introduction of talking pictures more or less coincided with the general adoption of panchromatic negative stock. This was a highly convenient but rather expensive coincidence. Carbon arcs were noisy and were replaced with tungsten bulb lamps. These lamps were produced in various sizes, from 1 k.w. to 5 k.w., and the use of improved optical systems gave a degree of control hitherto considered unattainable.

Lighting for Colour Films.

But colour films could not be shot with tungsten lamps—they were far too yellow. During the thirties, intensive research resulted in great improvements being made to the original high-intensity arc, and a very practical and comparatively silent type was evolved. For some years this lamp has been used for Technicolor and other colour films, in a variety of types burning from 65 to 150 amps each. The amount of light required for Technicolor shooting was then between 300 and 1000 foot-candles, compared with 50 to 150 for black-and-white work.⁹ The load of electric current taken on a large exterior set for colour work might be as much as 20,000 amps, and 2,000 to 5,000 amps is quite a normal load.¹⁰ Apart from supplementary power plant, additional ventilation in the studios became necessary. With over a hundred of these high-intensity arcs burning, the heat is intense and there is a considerable amount of smoke produced. These Technicolor loads can be compared with 500 to 2,000 amps for black-and-white shooting, though special sets and deep focus photography (as in *Hamlet*—in which the camera aperture was f/5.6 to f/11 compared with the f/2 to f/3 normally used) naturally necessitated light almost as intense as Technicolor lighting.

The modern Technicolor film process being now introduced gives a far higher effective

film speed. The new type Technicolor needs lighting of little more than equal intensity to the black and white process.

The latest development of carbon arc lighting is to be seen in the Mole-Richardson "Brute" lamp, which consumes 225 amps and gives as much light as three 150-amp H.I. arcs.

Another recent development is the re-appearance of the mercury-vapour lamp in the form of the high pressure mercury-cadmium lamp, known as the "compact light source lamp." In the old days the mercury-vapour type had to be tipped to start it burning. In the modern version the "compact light source lamp" has only to be warmed up for a few minutes before striking. In the compact light source we have a light which in its highest powers of 5 k.w. and 10 k.w. gives an intense white light, is cool burning, noiseless, and does not require new carbons, trimming or critical adjustment. In its G.E.C. 2½ k.w. form it is frequently used for illuminating backings and burns all day long without attention.

Advances in Cameras

Now let us turn to cameras. During the last fifty years the cinematograph camera has developed from the simple wooden box type camera to a most elaborate scientific instrument. At the same time the cost has risen quite considerably. There was the Prestwich camera¹¹, the first precision cinematograph camera to obtain general approval, which was produced in a beautiful mahogany case with brass fittings and sold for £57 10s. This was closely followed by the Moy camera on similar lines, but having inside magazines and being fitted with various devices for obtaining trick effects, including the ability to reverse. Up to 1912 all the best cinematograph cameras were made in England and beside these makes already mentioned, there were the Darling, the Williamson and the Aeroscope (made by Newman & Sinclair) cameras, which were sometimes sold by various equipment firms under their own labels, and it is a curious thing that though British cinematograph cameras were supreme all over the world, the lenses were invariably

of German manufacture. In cine cameras various forms of claw movement are used ; the maltese cross movement is not used. In 1914 the Moy was loosing ground to the French made Debrie camera, which had a watch-like mechanism and 400-ft. internal magazines side by side. The Pathé, another French camera, had its crank handle at the back and magazines on the top. This camera was standard in many studios for a long time and all the early D.W. Griffith's pictures, including *Birth of a Nation* and *Intolerance*, were photographed on Pathé cameras. In 1914 a Pathé professional camera outfit cost £72. It was not until about 1920 that an American-made camera was being extensively used in Hollywood—the Bell and Howell. This beautifully made camera cost £300, then considered to be a fantastically high figure. The register pins (which had actually been invented by Newman) were introduced in this camera in conjunction with the shutter movement, giving a steadiness which has never been surpassed. Another camera of the period was the Wilart (a heavy all-metal imitation of the Pathé), and the British Vinten, a revolutionary type of camera with a single claw intermittent movement and a built-in tripod head integral with the camera itself. Some of these cameras had automatic shutter fades. By pressing the button on the camera while the handle was being cranked the shutter aperture could be steadily opened or closed during shooting to give a fade in or a fade out effect. This effect had previously been obtained by slowly opening or closing the iris diaphragm of the lens.

It must be realised that all trick effects had to be obtained in the actual camera. Dissolves from scene to scene involved very careful marking of the film, which was unloaded and boxed up until the second half of the dissolve was exposed, sometimes weeks later, in a totally different place. Nevertheless, elaborate "montages" were shot in this manner, involving dozens of scenes superimposed and dissolving. Fine examples were to be seen in many British pictures, notably in Maurice Elvey's *Hindle*

Wakes, in which Basil Emmot, the cameraman, achieved a new "high" in camera-made montages. When I mention that one of the dissolving scenes was hand-cranked by this cameraman while riding backwards on the Blackpool scenic railway, you will realise that self-hypnosis is one of the most valuable characteristics of the cinematographer !

All of these cameras were noisy, however, and in 1929 talking pictures compelled silence. At first, slow-motion type cameras—the quietest available at the time—were adapted and used in portable booths similar to telephone kiosks until the sound-proof camera "blimp" and the present silent Mitchell, Debrie, and other cameras were evolved.

Present-day Cameras

The motion-picture camera outfit of to-day is a beautiful piece of precision engineering. The American Mitchell and the British Newall are of similar type, enclosed in sound-proof blimps, and the British Vinten has a blimp which is integral with the camera itself. A reflex device on the shutter of the Vinten allows the operator to view the scene through the lens that is being used for shooting, thus eliminating the parallax problems associated with the use of a viewfinder. The practice of following a scene by viewing through the actual film is no longer practicable.

Compared with 1910, it is interesting to note that British lenses now lead in the film world, and 90 per cent of the lenses used in Hollywood studios are of British manufacture. It is also interesting to note that the cost of a comprehensive cine camera outfit has risen from £52 10s. in 1910 to £6,000 in 1952. The cameraman of 1910 wore a cloth cap, with the peak at the back. The cameraman of 1952 is a dignified gentleman—a Fellow of the R.P.S., a Member of the British Society of Cinematographers and, even, a Member of the British Kinematograph Society. Incidentally, he seldom touches a camera and is known as "Director of Lighting" !

Developing and Printing

In the early days of film production, almost every British studio did its own developing and printing of daily rushes, and some even carried out release printing. With the exception of the Hepworth and Barker studios, where automatic processing plants were installed, the simplest types of flat wood frames and tanks were used. The very high capital cost of modern automatic developing machinery, which is capable of dealing with huge footages, has now made it economically unsound for studios to run their own laboratories. One or two studios have small plants for dealing with special effects work, but in the main, laboratory work is carried out by specialist firms. Much of the trick work formerly done in the camera, opticals, dissolves, fades and titling, is now carried out by the laboratories.

Special Effects.

However, there are certain tricks used on the studio floor and the use of these is increasing. There is the rear projection system, used in the studio for projecting moving backgrounds on a translucent screen behind the artistes. This is normally used for projecting the passing scenery, as seen through the windows of trains or cars. More difficult is "static" back-projection, in which the foreground setting is stationary, e.g. a scene in an office in which buildings and moving traffic can be seen through the window. Everything seen outside the window is projected on a screen, but the slightest unsteadiness of projection would give the game away and the result would be unacceptable. The normal maltese cross type of projector is not good enough for this work, and special projectors have been evolved in which a claw movement and register pins are used, as in a camera movement. Special care has to be taken in preparing the prints for static back-projection, since the slightest discrepancy in perforation gauge due to shrinkage or other causes, will result in unsteadiness. This trouble has decreased since the introduction of tri-acetate safety base.

Travelling Matte

Another system which is growing in popularity, both in black and white and colour, is travelling matte. The artistes are photographed in front of a blue background. In processing, the vivid ultramarine blue of the backing is utilised as a means of producing a silhouette (or mask) of the foreground figures. In printing, this mask is used with a print of the required background to cut a clear space silhouette of the artistes. The space is then filled up with a second printing operation, giving a composite picture of artistes in the studio, with, say, a background of Paris. Many of you will have seen *The Lavender Hill Mob* which has a sequence at the top of the Eiffel Tower. This sequence was entirely shot with the travelling matte system and was highly successful.

Back projection and travelling matte each has its own particular uses and limitations. Both call for precision of the highest order in equipment, material and handling. Both are expensive—but they enable shots to be taken which would otherwise be even more expensive, or which would be impossible to obtain.

Mobile Studio Unit

I must now refer to another method of getting the real backgrounds on the screen—the mobile studio unit. English weather being what it is, an exterior location is a hazardous enterprise, and expensive units have been known to wait for weeks, even in summer, to complete their work. By provision of lighting generator, lights and various specialised equipment, it is possible to improvise a small local studio where sets can be shot while waiting for the weather. This procedure was carried out for the shooting of *Whisky Galore* in the Isle of Barra, Outer Hebrides, where a church hall was converted into a temporary studio. Small prefabricated sets and sections which could be assembled and reassembled were sent to Barra, and the unit was able to shoot useful footage every day—wet or fine. The same method was used by Ealing Studios when two or three weeks of exteriors in the Liverpool area were required



Fig. 4. Portable magnetic recording equipment being used on the production of "The Titfield Thunderbolt."

for *The Magnet*. Of course, there are obvious limitations to the types of set which can be constructed for mobile studio work, but this facility is a most useful one.

Sound Recording

Sound Recording has made great progress since 1922. Originally, all recordings were made simultaneously with the scene being shot, including background noises and music. Recording has progressed organizationally as well as technically, and the final sound of the picture is now evolved from many different sources. The original dialogue on the studio stage, plus post-synchronized dialogue (for exterior scenes and others where it was not possible to get a good recording), together with music and effects tracks are re-recorded. Photographic and magnetic tracks are used, the latter having progressed very considerably during the last year or so. Unperforated magnetic tape is frequently used on exteriors, with perfect synchronization, using a secondary synchronizing track by the side of the sound track. There is a big future for both magnetic tape and for perforated magnetic film, both of which enable economies to be made in the consumption of photographic sound film. Magnetic tracks are transferred to the photographic film for editing and release purposes, but only the selected takes are so transferred.

Time does not permit me to cover all the departments which function in a modern studio. Plaster plays an important part in set construction, and so does metal work. In conjunction with the Art Director, the Construction Manager co-ordinates the work of a varied number of crafts—plastering, iron-work, woodwork, papier mache, tubular scaffolding, scenic painting, set painting. The Chief Electrician handles the supply of power and lights, also the practical lights on the sets (electricity or gas), compressed air, water, or other set requirements. The Special Effects department provide steam, smoke, fire, flames, cobwebs, snow, rain, icicles and the like, and assists considerably with model shots.

Time, labour or material saving devices which have been introduced in the last year or so include the "silent-turnover" (a method of applying accurate synchronizing marks to sound and picture), magnetic film and tape recording, the Stereopticon (for back projection of photographic plates), and the radio telephone.

R/T Facility

At Ealing Studios great use has been made of the R/T facility and a commercial licence has been obtained from the Postmaster General.¹² When a location unit is working in the London area, the studio



Fig. 5. Portable magnetic recording equipment being used on the production of "The Cruel Sea."

production office can keep in touch with it by means of a transmitter and receiver fitted in one of the studio cars. Occasionally this facility is used on distant locations, when the home station is installed at the location headquarters. On *The Cruel Sea*, for instance, the production office in the hotel at Plymouth was in constant touch with the corvette out at sea. In addition, the corvette was in touch with a camera ship by walkie-talkie. For *Titfield Thunderbolt* R/T links were used between the director and the train and with the Production Office.

In the early silent days, projection of the previous day's rushes was rather a haphazard procedure. A projection machine was set up in any convenient room—prop room, canteen or workshop. To-day, the Projection Department of even a medium sized studio contains two or three theatres which are in operation all day long. Very careful daily checks are made of screen illumination and sound level. When a film unit is on distant location, daily rushes are sent from London and viewed by the unit at a local cinema, after the last public performance. On occasions, we fit up a portable projector in a small hall. Recently, during the filming of *The Titfield Thunderbolt* at Limpley Stoke, near Bath, a small theatre was improvised in a disused leather works. In view of the fact that Technicolor pilots were to be judged, as well as the usual black-and-white prints, and cut sequences, a Simplex projector (for running separate sound and picture) was installed, including an H.I. arc. The power for this installation was provided from a generator driven by a water turbine about 100 years old!

Possible Future Trends

In the small space of a survey paper, it is not possible to deal in very great detail with varied equipment and techniques used in a film studio. Each day is virtually a prototype and has its separate problems.

As for the future—it is quite easy to hazard fantastic forecasts ; electronic-stereoscopic this and that ; plastic, streamlined atomic gadgets, and so forth, in the Wellsian manner. Dogmatic assertions of revolutionary changes I prefer to leave to the politicians, who are usually wrong anyway. I assure you that studio technicians will continue to develop equipment which will broaden the canvas of motion picture production in every way. It may well be that certain devices developed for television, such as the Vinten run-truck or the electronic camera, may find a place in the scheme of things. Colour is the next obvious and normal trend, with a tendency to larger theatre screens which would probably have some effect upon the choice of focal lengths of lenses in the taking cameras.

My own feeling is that all future developments in the studio will be towards making film productions bigger, more colourful and dynamic than is possible on television. This will mean shorter dialogue sequences, more movement, greater variety of scenes and slicker cutting. By utilisation of the huge volume range of modern sound projection, with zoom lenses and big screens and with loud speakers in various parts of the auditorium, spectacular effects can be achieved by the technicians at the theatre, without any fundamental departure from present methods and without involving huge capital outlay.

It may well be, of course, that new devices for stereophonic or stereoscopic pictures may be evolved, but any such technical innovations must necessarily be handled cautiously and be secondary to the main objective of telling a story. Technical stunts are usually nine-day wonders. Nevertheless, I venture to suggest that within the framework of the Society there can be built up such a measure of co-operation between the technician of the theatre and the technician in the studio to exploit these devices in a showmanlike manner, that will enable the motion picture to retain its hold as the most popular form of entertainment.

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THE ROYAL PHOTOGRAPHIC SOCIETY

Centenary Exhibition

TO mark the 100th Anniversary of its formation, the Royal Photographic Society and the Science Museum brought together a unique collection of photographs, books and apparatus at an exhibition held at the Science Museum, London, in March, 1953.

Specimens of early developments of cinematography were shown. Some of the earliest include the Thaumatrope, the Phenakistoscope, the Fantoscope and the Stroboscope. Rudge's "Life in the Lantern," a projector made in 1895 and forming part of the Will Day Collection, were on view. This was one of the earliest instruments to produce an illusion of motion from a series of photographs. It embodies an instrument mechanism which, in principle, is similar to the maltese cross movement of the modern machine.

It was as a result of studying this machine that William Friese-Green produced the first practical camera for use with perforated film in 1899. Some of the actual celluloid used by Friese-Green was on show. It was notched at the edges whilst passing through the projector. Amongst other apparatus of Friese-Green's to be seen was a stereoscopic still camera built in 1890.

Another early camera on view was "Le Cinepar," patented by Parnaland in Paris in 1896. The film used in the camera measured 32mm., with a single line of perforations at the side of each picture. The camera could be converted to a projector by removing the metal back-plate and placing an optical lantern behind the apparatus.

The first successful camera with automatic driving

mechanism could be seen. This was the "Aeroscope," invented in 1910 by Proszynski. It was driven by compressed air contained in cylinders charged by a detachable hand pump.

Amongst the colour apparatus on view was the Kinemacolour camera and projector mechanism devised by Urban Smith in 1906. This was the first successful machine made for the projection of pictures in "natural" colours, alternate red and green filters being revolved between the film and the lens. Other interesting mechanisms on view were the Kinemacolour camera built in 1909 by Moy and Bastie to Urban Smith's specifications and the experimental projector used by Friese-Green in 1897 for two-colour films.

Early sub-standard apparatus included the Birtac camera-projector designed in 1898 by S. Birt Acres, which used 20-ft. lengths of 17.5-mm. film. Perforated along one edge only, it was possible to take 640 pictures $\frac{1}{2}$ -inch by $\frac{3}{8}$ -inch. There was also the Biokam combined camera, printer and projector, with a capacity of 25-ft. of film.

The Higginson shutterless projector made in 1921 was shown. In this projector the film moved continuously before the lens, and a system of rotating mirrors reflected the images on to an inclined mirror above the lens, from which the beam reached the screen.

Finally mention must be made of the first Hurter and Driffield photometer of 1887, which used a bunsen grease-spot, and the first bench photometer of the same manufacturers, made in 1890.

PERSONAL NEWS OF MEMBERS

Members are urged to keep their fellow members informed of their activities through the medium of "British Kinematography."

K. BARON HARTLEY has been elected Hon. Treasurer of the Scientific Film Association.

DR. L. KNOPP has been awarded the Fellowship of the Illuminating Engineering Society.

TECHNICAL ABSTRACTS

All the periodicals here abstracted may be seen in the Society's Library

A D.C. AMPLIFIER FOR USE IN pH MEASUREMENTS

Morton, C., *Elec. Eng.*, **25**, No. 300, 78, 1953.

A D.C. amplifier is described for use in pH measurements. Automatic compensation is provided for zero correction due to ± 20 per cent changes in supply voltages and for changes in the electrode EMF due to temperature changes.

621.314.12 : 541.132.3

R.J.T.B.

PRACTICAL ASPECTS OF RECIPROCITY-LAW FACTOR

Tupper, J. L., 20, *J. Soc. Mot. Pic. & Tel. Eng.*, **60**, 20, 1953.

The occasional failure of sensitometric data to provide a reliable indication of the practical performance of photographic materials is usually attributable to the failure of the reciprocity law. The effect of reciprocity-law failure in the characteristic D-log E curves of various films is shown graphically. The influence of developing time and of the temperature of the film on the effectiveness of exposure at various intensity levels is discussed. Certain generalizations are made about the failure of the reciprocity law which may be helpful in reconciling differences between laboratory measurements and the results obtained in motion picture practice.

771.534.56

AUTHOR'S ABSTRACT.

SHOOTING LIVE TELEVISION SHOWS ON FILM

Freund, K., *Ibid.*, 9.

Experience in shooting live television shows on film is described, in which three motion picture cameras were used instead of television cameras, with overhead lighting and in the presence of an audience. Subject contrast was measured by means of a flare-free brightness photometer.

778.53 : 621.397.9

AUTHOR'S ABSTRACT.

A NEW AUTOMATIC FILM-THREADING MOTION PICTURE CAMERA

Badgley, G. J., and Fraser, W. R., *Ibid.*, 49

The new automatic film-threading motion picture camera designed and built by G. J. Badgley at the Naval Photographic Centre provides : (1) a 16mm. motion picture camera that can easily be loaded, quickly threaded and operated under adverse conditions normally encountered by naval photographers ; and (2) a motion picture camera that can be used for recording radar and television images appearing upon cathode-ray tubes.

778.531

AUTHORS' ABSTRACT.

FILM PROJECTION USING IMAGE-ORTICON CAMERAS

Chipp, R. D., *J. Soc. Mot. Pic. & Tel. Eng.*, **60**, 1, 1953.

Presented here are the results of over a year's use of the image-orthicon cameras for all film transmitted by television station WABD, New York, totalling approximately 2,000 hours. In addition to brief consideration of the technical problems encountered, cost, reliability, convenience and other operational factors are discussed.

778.554 : 621.397.1

AUTHOR'S ABSTRACT.

ANIMATION STAND OF NEW DESIGN

Bowlds, E. H., *Ibid.*, 58.

An animation stand engineered to meet all requirements of flat-bed stop-motion animation for 16mm. and 35mm. film is described. It is designed to combine ease of operation with facilities for the most intricate effects shots and special techniques. A unique peg and platen system allows larger field sizes than hitherto available on similar equipment. The use of ball bearings at the friction points eliminates power-driven mechanisms and simplifies maintenance.

791.44.02

AUTHOR'S ABSTRACT.

NEW EQUIPMENT

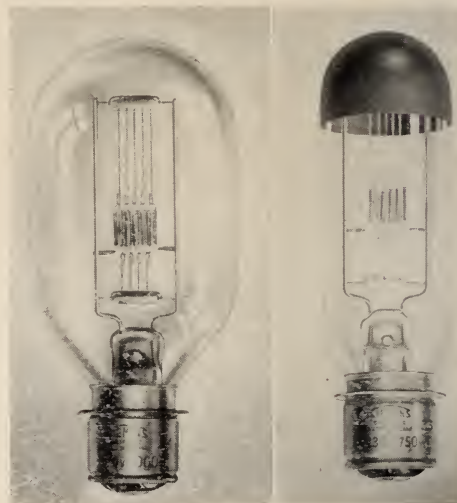
As in the case of technical papers, the Society is not responsible for manufacturer's statements, and publication of news items does not constitute an endorsement.

PROJECTION LAMPS

Bi-planer projection lamps have, in the past, been available only in the 100-300v range. The Siemens Research Laboratories, in collaboration with Messrs. Aldis Bros., have now developed lamps of 500 w., 750 w. and 1,000 w., for operation at 200-600 v.

This development enables equipment using such lamps to be connected to the normal mains without the use of a transformer. A considerable saving both in cost and weight of the projection apparatus has thus been effected.

The lamps are distributed by The Siemens Electric Lamps and Supplies, Ltd., 38-39 Upper Thames Street. London, E.C.4.



R.P.S. CENTENARY CELEBRATIONS

THE programme now being prepared by Howard Thomas, M.B.K.S., entitled "Preview of To-morrow's Newsreels" to take place on April 2 and April 22, 1953, at the Gaumont-British Theatre, Film House, Wardour Street, W.1, will survey the story of newsreels so far, and provide a prophesy, with practical illustrations, of coming developments in news-film presentation. Admission is by ticket only obtainable in advance from the Secretary.

The lecture will begin with excerpts from the oldest newsreel library in the world, Pathé's, including pictures of the Boer War, the Funeral of Queen Victoria, the activities of Edward VII, and the Investiture of the Prince of Wales.

In bringing the newsreel story up to 1953, there will be a selection by each newsreel company of its outstanding stories, including some of the news scoops of the century. There will be examples, too, of "cameras on the move," pictures taken with automatic cameras, including the newsreel film from a rocket showing the curvature of the earth.

Among new developments will be pictures taken with high-speed film stock, showing results obtained without any artificial lighting.

Coming to the possibilities of colour in the newsreels, Howard Thomas will give some idea of the preparations being made and of films in colour made for record purposes but never before shown in public. There will be a foretaste of sporting events of 1953 in colour, and a flashback to early experiments, including hand-coloured films and the Pathé colour film made of the last Coronation.

New developments to be considered are the use of newsreels both in television and large-screen television. Inevitably there will be speculation on newsreels' part in stereoscopic films, with a surprise at the end for the audience.

Howard Thomas is executive producer of Associated British-Pathé and, at the time of the lectures, he will have become Chairman of the Newsreel Association. Mr. Thomas will be responsible for filming the Coronation in black and white for the newsreels and in colour for *Elizabeth is Queen*.

BOOK REVIEW

Books reviewed may be seen in the Society's Library

EXPOSURE METERS AND PRACTICAL EXPOSURE CONTROL. J. F. Dunn, M.I.E.E., F.R.P.S.
Fountain Press, 35s.

Undoubtedly this is the most important work that has yet been published on methods of exposure deter-

mination. Before writing this book, the author was well known in the photographic world as the joint inventor with the late G. S. Plant of the S.E.I. exposure photometer. However, despite the preference he can be expected to have for the photometric approach to the exposure problem Mr. Dunn devotes

only a modest proportion of his text to this aspect of the subject.

The book is in fact very well balanced and so written as to be useful to both the advanced amateur and professional photographers. A quarter of the text deals with the fundamental theory of exposure requirements including such basically important matters as definitions of light units and the principles of tone reproduction. The theoretical section also explains the difference between shadow, average and "key-tone" brightness measurements for the purpose of exposure estimation. There is some evidence in this section that the author is not as well acquainted with 35mm. commercial laboratory practice as he is with 16mm. reversal methods. The grading or timing stage of motion picture printing is entirely disregarded in an argument supporting the "highlight" method of exposure estimation for negative-positive cinematography.

Adequate attention is given to exposure tables and calculators and proper stress is laid upon the desirability of all such aids falling into line with either the appropriate British Standard or the American Standard specifications. The B.S. tables are included in full.

In accordance with modern tendencies, relatively little space is given to extinction meters. But many available integrating photo-electric instruments are described and illustrated, and the principles and

limitations underlying their use are fully discussed. The substitution or "key-tone" method of using a reflected light meter is explained.

The advantages of measuring incident light for exposure estimation are considered and the few available incident light meters and attachments are illustrated and described. The merits of taking a single incident light reading are compared with those of the "duplex" or dual reading method devised and preferred by the author.

Exposure photometers are discussed in general and the S.E.I. and "Spot" instruments in particular. Separate sections are allotted to the use of these photometers in still monochrome work and motion picture and colour work. This latter division again emphasizing the author's tendency to make too great a distinction between monochrome still photography and cinematography.

There are numerous tables dispersed throughout the book including one giving up-to-date Film and Plate Exposures Indices in B.S. (logarithmic) and A.S.A. (arithmetical) forms.

The book is mainly illustrated with good quality half-tones and line diagrams but there are also one or two colour reproductions. The black and white tone reproductions really do clarify and augment many of the explanations contained in the text.

J. H. R. COOTE.

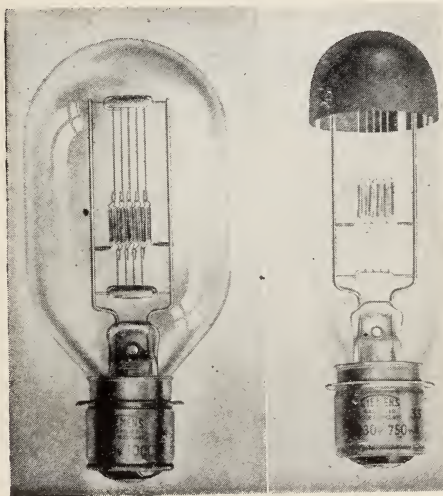
Current Releases



PROJECTOR LAMPS

Siemens Research Laboratories at Preston, Lancs., have devoted much experimental work to the problem of manufacturing a satisfactory high voltage biplaner filament lamp and, have now developed lamps of 500, 750 and 1000 watts for operation at 200/260 volts.

This development enables equipment incorporating such lamps to be connected direct to the normal 200/250 volts mains without the introduction of a transformer, to step down the supply of 100/130 volts.

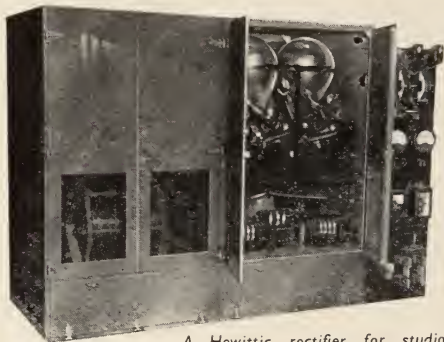


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CECIL M. HEPWORTH An Appreciation

The death of Cecil M. Hepworth has been deeply felt in every section of the British film industry. The Secretary has had many letters expressing appreciation of his great qualities. We can publish only a few sentences from some of them.

From Stanley Faithfull (Member), his friend and colleague since 1896 :

"The twenty-six years spent with him were years of very great happiness. The cinematograph industry has lost one of its great pioneers who did, unknown, much more than give to it his inventive genius."

From Tom H. Williamson (Member), President of the Veterans' Association and one of Mr. Hepworth's oldest friends :

"His energy and perseverance coupled with an inventive spirit established him as a real pioneer, seizing every opportunity and developing and improving the meagre apparatus at his disposal to produce and process the short films with which the trade started.

In June, 1898, he patented the first continuous processing machine which was installed in his laboratories at Walton-on-Thames, the forerunner of the processing laboratory of to-day. Until the last he was very fully interested in the trade and its very modern intricacies."

From Arnold Williams, employer and friend of Mr. Hepworth for the last 17 years of his life :

"Cecil Hepworth joined National Screen Service Limited in the middle 1930's as Technical Adviser. He was a quiet, almost secretive man when he had a problem on hand, but a man with a vast fund of technical knowledge and practical experience at the immediate disposal of anyone who needed advice.

He had a dry caustic wit which was only sharpened on the inflated or the pretentious. He never lamented the past. To all of us he was the same kindly gentle soul, treating the newest boy or office cleaner with the same quiet courtesy as his oldest friends.

We who have known him for many years grieve for the passing of a good and true friend and colleague and we are sure that the world will realise that in the death of this pioneer of the cinema a great and truly noble man has been lost."

It was typical of the man that in 1951 he wrote in his autobiography *Came the Dawn* :

"I am happy in this job . . . I have numbers of friends, dear friends, in this company and in the film trade generally. Fate has been good to me after all. I am content."

One of the last things Mr. Hepworth did during his illness was to prepare a paper for the British Kinematograph Society, which was read before a meeting on January 7, 1953, by his daughter Miss Barbara Hepworth.

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THE CONVENTION

May 9, 1953

THIS is the fourth occasion on which the Society has held a Convention. It is desired to draw your particular attention to the event since it is felt that many do not fully appreciate its significance.

When you received your programme you will have noticed that the first item is an Informal Luncheon, which will take place at Kettners Restaurant. Many times in the past members have expressed the wish for such an event and it is hoped that you will avail yourselves of the opportunity to come along and meet your friends. The tickets are 15s. each.

The next item on the programme is the Ordinary Meeting of the Society. This is the only opportunity in the year for members in all branches of the industry to gain a broad outline of the overall activities and to assist in formulating the Society's general policy. You will also learn who are to be your Officers for the forthcoming year, your Members of the Council

and of the Divisional Committees. These are serious matters in which you should be playing an important part.

The installation of the new President will mark a high-light in the proceedings and your support and encouragement will stand him in good stead at the outset of his term of office.

Later on, the scene will change to the large theatre at Film House, when some of your colleagues will be conferred with the Fellowship of the Society. This honour is awarded for outstanding work and service to the industry. The Newman Memorial Award is presented also to the members of the industry responsible for the technical achievement of the year.

The afternoon's proceedings conclude with the Presidential Address, and after tea Ealing Studios' film *The Titfield Thunderbolt* will be shown for your entertainment and that of your friends.

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OBSERVATIONS ON CINE-STEREOSCOPY

IT is probably to arrest the serious decline in cinema patronage, that the leading members of the film industry in America have seized upon stereoscopic—or three-dimensional—picture presentation as being one of the most likely means to re-attract attendances. It is not known whether it is intended to exploit the systems merely to secure quick benefits and to reap an immediate harvest from their novelty value, or seriously to develop them with the object of making them permanent and important features of motion picture presentation.

If the former is the case, it is possible that the gross effects of decoupage and of pseudoscopy which we have seen in recent American films, can be accepted if it is thought that they accentuate the novelty of the technique. Similarly, the limits of non-accommodation convergence can be ignored to secure startling effects, and hyperstereoscopic views can be intermixed indiscriminately with geometrically distorted close-up shots if they provide startling psychological jolts. With only a short term policy in mind, there is no objection to forceful exaggeration and unnatural perspectives. But films containing such effects must be restricted in length if eye-fatigue is to be avoided. Perhaps a few interest shorts between normal 2-dimensional features will provide a suitable fill-up without laying the industry open to complaints of headaches and eyestrain.

But if three-dimensional films are to take a prominent and permanent position in cinema programmes, the laws of stereoscopic vision cannot be broken indiscriminately as they have been. The unnatural juxtaposition of sequences coupled with incorrect image separation, which has been observed in these recent films, cause visual fatigue, headaches and psychological discomfort. It is reported in the press that the public has already complained. The blame erroneously has been placed upon the polaroid spectacles. This is unfortunate because spectacles are a form of analyser common to many three-dimensional systems and it may be thought that all the

systems therefore suffer from the same objection. The wearing of these spectacles, which are not substantially different from sun-glasses, do not of themselves cause eye-fatigue or headaches. It will be most unfortunate and likely to cause irreparable damage to the industry if complaints wrongly associated with the spectacles, become widespread. They can be avoided only if film producers, cameramen, laboratory technicians and projection engineers realise that the fundamental principles of stereoscopy cannot be ignored or disregarded.

Stereoscopy is not a new subject ; indeed the theory of stereograms was known and many excellent examples were exhibited long before Louis Daguerre and William Fox-Talbot formally communicated to the scientific world their discoveries upon which are founded the present-day photographic techniques. Probably the first stereograms were drawn by Giovanni Battista della Porta in the late 16th century ; these were referred to by François d'Aguillon in his *Traite d'Optique* published in 1613.

Stereoptics has been the subject of much investigation and research since that date, and although the geometry of binocular vision is well established, and experiment and research have provided accurate information of the physiology of the eye, the complete theory of binocular vision is still a controversial subject. Prof. J. D. Everett, F.R.S., has, perhaps, put forward the most probable explanation : that to each point in the retina of one eye there is a *corresponding point* similarly situated in the retina of the other eye. In normal binocular vision, and under ordinary viewing conditions, the impression produced on one of these points is indistinguishable from the other, and when both eyes are simultaneously and similarly impressed, the effect is simply more intense than if one eye were impressed alone. The two eyes in order to see a single point must, however, turn in their sockets, or in other words, must, by muscular effort, cause the optic axis to converge upon the point to a greater or lesser degree so that

the two images of the point fall upon corresponding points on the retina. This convergence of the optic axes provides the principal means for judging distances, which is more precise than that obtained by adjusting the foci of the crystalline and cornea lens of the eyes. The relative parallax displacement of near and distant objects also furnishes information by which the distances between objects are assessed.

It is, however, fairly well established that although the accommodation and convergence of the eyes and the parallax displacement of their images are the principal causes of stereoscopic vision, many other simultaneously experienced effects are interpreted as differentiations of distance. Appreciation of relief or solidity of objects is importantly involved in the complete apprehension of space relationship.

These secondary effects are both visual and psychological; they involve the appreciation of the finest nuances of light intensity and direction, of hue and shade, and of perspective. These are related to psychological experiences and memory, which altogether create in the spectators' mind a world of reality and of space.

In the more recently produced films, there has been a tendency to increase the stereoscopic range by introducing greater ocular separation of the cameras and by magnification. These devices undoubtedly increase stereoscopic perception. It is not difficult to show that if the interocular distance is increased by optical means, say, n times, and that a lens be introduced into the system that gives a magnification of, say, m times, the stereoscopic range will be increased by $m \times n$. If this is applied to the general formula it will be seen that the visual error in the perception of distance increases as the square of the distance of the object—or that the degree of stereoscopic perception varies inversely as the square of the distance from the observer to the principal plane of the object. The theory of employing a lens separation different from that of the human eye giving the most satisfactory and natural relief has been well explored by Colardean, who deduced the

important general rule that the linear dimensions of an image seen in a stereoscope are inversely proportional to the lens separation employed when taking the photograph, or, in other words, if the stereoscopic image is to be seen at a definite distance, the scale of linear dimensions of the object photographed will vary inversely as its distance from the lens. One of the difficulties that confront realistic stereoscopic motion pictures is that the acceptance angles of camera lens are appreciably less than those of the human eye, so that the observer is continuously aware that he is viewing only a portion of the real field of vision; this awareness is particularly apparent in close-up shots. Col. L. E. W. von Albada investigated this problem, and he produced a wide-angle stereoscopic lens system which avoided the effects of exaggerated perspective and distortion, which are a feature of ordinary wide-angle lens. It was claimed that this system is practically corrected for distortion over a diagonal field up to 80° , and chromatism is negligible. It should, however, be borne in mind that the use of wide-angle shots, however desirable they may be, must be correlated with the conditions of viewing in normal cinema auditoria, and screen dimensions must be commensurate with the observer's viewing position.

It is interesting to note that Col. Albada's researches were commenced over forty years ago, and they have formed the basis for the Hypergonar wide-angle lens system that has since been developed by Prof. Chretien, and recently adopted by 20th Century-Fox for their Cinemascope.

A matter which must be strongly emphasized in all considerations of three-dimensional photography is that orthostereoscopic conditions—that is, a reproduced scene in a form that is geometrically congruent, in perfect linear proportions, and in apparently perfect space relationship, are not ordinarily possible. It may also be emphasized that distortion in terms of both image proportion and space relationship are inevitable in all forms of stereophotography, whether cine or still. Many workers and producers have,

somewhat naïvely, asserted that their systems are distortion-free, that they provide "natural vision," and that their results are true to life. This is not possible. With a pair of lens of given focal length and given separation, film images can be secured of certain scenes (the nearest object in which is a considerable distance from the camera), which, if projected upon a screen of given dimensions will give a true geometrical and space effect to a spectator sitting at a given distance from that screen.

Compliance with such restrictions would be wholly unacceptable for entertainment films shown in a normal cinema and the problem, therefore, is to determine the limits of distortion that are acceptable without causing eye-fatigue and discomfort.

It is necessary to study the problem in all its aspects and it is with the view of correlating all the existing knowledge on cine-stereoscopy and preparing a report for the guidance of film industry in this country that the B.K.S. has formed a Committee of investigation. The Committee will be representative of all sections of the trade, and the B.F.P.A., the K.R.S., the C.E.A. and the A.S.F.P. and laboratories have been invited to appoint representatives. It is thought that the fundamental principles of binocular vision as far as concerns motion picture photography and projection should be clearly stated; that with the aid of specialist oculists, the principal causes of physical and psychological fatigue and strain should be known, so that, by the avoidance of these causes, three-dimensional films may be viewed without discomfort. It is hoped that in addition

to a summary of the camera equipment currently in use, and of optical printing corrections that can be applied, guidance will be given that will ultimately lead to standardization. It will be necessary also to make known to cinema proprietors the conditions under which stereoscopic films should be exhibited and of the alterations that are required to equipment and screens, whereby the best practicable presentation may be given.

It is probable that test films for alignment purposes will be prepared to assist projectionists in locating and checking the position of projectors relative to the screen.

The closest liaison will be kept with American interests. The major American producers, through the Motion Picture Research Council, are actively engaged at the present time in efforts to give guidance to those making three-dimensional films and at the same time the Society of Motion Picture and Television Engineers has formed a committee to deal with the problems of the exhibitor. Already draft standards are being discussed; it is proposed that spool boxes should be 24 inches or 25 inches in diameter to accommodate 23-inch or 24-inch reels respectively. The latter will accommodate about 5,000 feet of colour film, permitting a programme length of 1 hour, 50 minutes with one interval. The increased inertia and loading caused by the larger reels may involve an increase in spindle diameters. Proposals are being considered for standard identification markings for left and right-hand films, projector and shutter alignment, alignment test films and basic nomenclature. These, and other matters will be considered by the B.K.S. Committee.

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THE QUALITY OF TELEVISION & KINEMATOGRAPH PICTURES

L. C. Jesty,* B.Sc., M.I.E.E. (Member) & N. R. Phelp*

Read to a meeting of the British Kinematograph Society on December 10, 1952

SO much has already been said on the subject of picture quality and associated problems,¹ especially as between television and motion pictures, that it is felt some justification must be given for further discussion of the subject. This justification arises from the many misunderstandings which appear to be current even to-day regarding the interpretation of such simple data as limiting resolution and gamma. In 1946 the authors initiated an extensive and somewhat laborious investigation of the *simultaneous* variation of five variables affecting visibility under conditions of picture reproduction. Whilst some of these, particularly resolving power and brightness had already been extensively investigated separately, very little data was available regarding simultaneous variation except perhaps for that of Cobb & Moss.² Even this did not include the constant adaptation requirement necessary for assessing performance under conditions of picture reproduction. The results of the authors' work up to 1951 have already been published in detail.³ In the present paper it is proposed to review these and subsequent work on 16mm. film, and to emphasize some of the conclusions which have been arrived at. Those sufficiently interested in the detailed arguments leading to these conclusions can of course refer to the discussion in the original publication.

It is interesting to find that the misunderstandings referred to above regarding the interpretation of simple limiting resolution and gamma data are amply supported by two recent papers. The first by Higgins and Jones⁴ shows for example that a particular photographic emulsion rated at 250 lines per millimetre gives a print which appears less sharp than one rated at 130 lines per millimetre. The second paper by Grimwood and Veal⁵ confirms the authors' findings that the overall brightness characteristic in terms of

the input/output characteristic (transfer characteristic) bears only a slight relationship to the straight characteristic (constant gamma) so familiar in laboratory tests. These somewhat disparaging remarks regarding the value of limiting resolution and gamma measurements do not of course reflect on their value as laboratory measurements. For such purposes as design work, process control, etc., they are invaluable.

SUMMARY OF EXPERIMENTAL METHODS AND RESULTS.

The following is a brief summary of the appropriate parts of the authors' earlier work already referred to and of some work since carried out on the same lines relating to the performance of 16mm. film. The experimental results are given in full in the original publication and are given in condensed form in Table I of the present paper along with the new information. Figs. 6-9 are reprinted from the original paper, and Fig. 10 gives the 16mm. data in the same form. Fig. 11 is also reproduced, but with the addition of the 16mm. transfer characteristic.

Various photographic, cinematographic and television systems were tested. Four parameters contributing to the limitation of vision were varied simultaneously and the value of a fifth one observed. The four deliberately varied were Resolution, Brightness, Contrast, and Viewing Distance (see Fig. 1). Teams of ten observers were asked to record the range over which they could resolve test patterns embodying the first three, whilst they were seated at various distances from the reproduction. The test objects were presented to them in random order for 10 seconds each. These test patterns were designed to embody a number of desirable requirements, some of which had not been used in combination, if at all, by previous investigators. Amongst these was

* With Marconi's Wireless Telegraph Co. Ltd. Research Laboratories

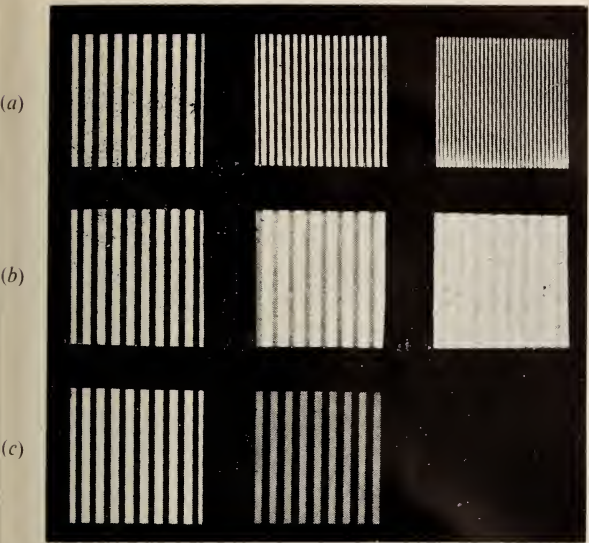


Fig. 1. Illustration of independent variation of the three parameters, Resolution, Contrast and Brightness. (a) Variation of Resolution at fixed Brightness and Contrast. (b) Variation of Contrast at fixed Brightness and Resolution. (c) Variation of Brightness at fixed Contrast and Resolution. (Reproduction process is inadequate to preserve contrast at low brightness.) Note : By increasing viewing distance patterns disappear progressively.

the use of an adapting field of fixed brightness surrounding the test objects. A special feature of the method was the use of an average picture (see Fig. 2) for making the initial adjustments of the reproducing system under test. Having secured the best possible reproduction of this standard picture it was removed and replaced with the test pattern shown in Figs. 3 and 4 without readjustment of the system under test. Since both picture

TABLE Ia.
TEST LINES/PICTURE HEIGHT FOR O × H, N/J, CENTRE OF FIELD

Contrast C	0.97			0.44			0.21		
Brightness	B	B/4	B/16	B	B/4	B/16	B	B/4	B/16
35mm. negative at low magnification	> 680	> 680	620	432	416	340	310	316	268
35mm. positive at low magnification	> 680	680	480	440	400	316	316	310	240
35mm. projection	440	400	316	340	340	197	287	292	188
16mm. reduction print at low magnification	352	316	178	143	143	—	120	120	—
16mm. reduction print, projection	216	132	118	149	143	—	146	138	—
16mm. reversal film at low magnification	504	472	394	260	260	260	220	220	220
16mm. reversal film, projection	448	408	340	260	260	240	240	232	194
16mm. print from 16mm. dupe negative from reversal original (Tutchings), projection ...	298	322	282	224	252	216	146	179	149
16mm. reduction print (Tutchings), projection	388	424	282	272	340	240	208	204	141
405-line telecine on 20-inch Monitor—									
Horizontal Test Lines ...	143	143	100	110	100	77	126	126	—
Vertical Test Lines ...	220	224	143	200	155	97	179	170	—

TABLE Ib.
TEST LINES/PICTURE HEIGHT FOR B/4 CENTRE OF FIELD

Viewing Distance	0 × H			4 × H			8 × H		
	0.97	0.44	0.21	0.97	0.44	0.21	0.97	0.44	0.21
	N/J	N/J	N/J	N/J	J/V	V/C	N/J	J/V	V/C
Contrast C	—	—	—	528	424	328	282	197	12
Visibility	—	—	—	528	424	328	282	197	12
Human Eye	680	416	316	—	—	—	—	—	—
35mm. negative at low magnification	680	400	310	—	—	—	—	—	—
35mm. positive at low magnification	400	340	292	248	216	158	138	118	79
35mm. projection ...	—	—	—	—	—	—	—	—	—
16mm. reduction print at low magnification ...	316	143	120	—	—	—	—	—	—
16mm. reduction print, projection	132	143	138	116	—	—	85	—	—
16mm. reversal film at low magnification	472	260	270	—	—	—	—	—	—
16mm. reversal film, projection	408	260	232	277	240	216	191	118	89
16mm. reduction print (Tutchings), projection .	424	340	204	212	—	—	108	—	—
16mm. print from 16mm. dupe negative from reversal original (Tutchings), projection ...	322	252	179	232	—	—	134	—	—
405-line telecine on 20-inch Monitor—	—	—	—	—	—	—	—	—	—
Horizontal Test Lines	143	100	126	170	143	134	130	112	64
Vertical Test Lines ...	224	155	170	200	179	164	170	128	64
							108	100	92
							132	120	108
							164	136	114
							120	112	92
							116	102	73
							124	112	76

and pattern were in the form of 19.2 inches by 14.4 inches transparencies it was a simple matter to arrange that the brightness of the adapting surround field in the test pattern was the same as the average brightness of the standard picture.⁶ The use of transparencies was of course essential in order to obtain an adequate brightness range for carrying out the tests. As a precaution against confusion from variations in the performance of the system in different parts of the picture area, the test patterns were limited to fixed positions in the field of view. Experience gained in the

take precautions to eliminate the effect of veiling glare from these measurements. The importance of the adapting field in actual picture reproduction is emphasised by the difference between the two characteristics (*b*) and (*c*) in Fig. 11. These show the transfer characteristics of a 35mm. film system with an average brightness field and with a black adapting field. It will be seen that the brightness range is reduced by about $2\frac{1}{2}$ times in changing from the black to the average brightness surround.

Strictly speaking, the reproduced picture



Fig. 2.
Authors' Standard Picture

Original 20 in. \times 16 in. Transparency

	Relative Brightness	Density
Highlight — cloud	100	0.3
Shadow — under central tree (con- tains detail visible on close inspec- tion)	2.5	1.9
Average for whole picture	36	0.75

early stages showed the possibility of recording a number of degrees of visibility of the test objects. This constitutes the fifth variable already referred to.

The input/output brightness (transfer) characteristics of the various systems were also measured, again in the presence of the adapting field. For this purpose the resolution/contrast component of the test pattern [*(a)* in Fig. 4] was removed leaving only the brightness component (*c*) in the surround field (*b*). The initial and reproduced brightnesses in the test positions were measured with suitable photometers. Due to the presence of the adapting field it was necessary to

brightness and size should have been standardised. This was not however possible, and the results must be taken as representative of the systems as they stood.

The range of variables covered by the test patterns was as follows :

Resolution

60 to 680 test lines* in the height of the picture. These were divided into fifteen steps with a ratio of the 4th root of 2.

* Test lines should not be confused with television lines. A test line consists of a black line separated from adjacent black lines by a white line of equal width.

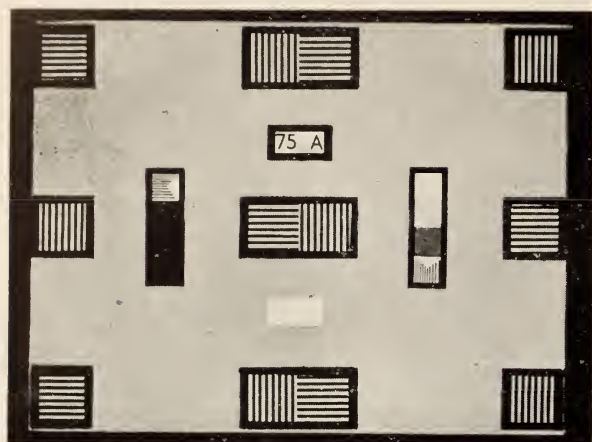


Fig. 3. Authors' test pattern showing one degree of Brightness, Contrast and Resolution.

Note disposition of test stations in constant brightness adapting field; arrangement of horizontal and vertical test lines; permanent reference wedge and test lines; numbering apertures.

Brightness

A range of about 1000 to 1 was covered in eleven steps with a ratio of approximately 2 (density difference 0.3) between them. The key value (B in Figs. 5-11, etc.) was the chosen highlight brightness in the scene corresponding to picture "white." The test patterns extended to twice this value to ensure that the system could be overloaded in order to detect any tendency to "crush" highlights.

Contrast

Three degrees of contrast were used corresponding to density differences in the resolution patterns of 1.50, 0.25, and 0.10. If contrast C is defined as:—

$$C = \frac{(\text{Brightness of light lines}) - (\text{Brightness of dark lines})}{(\text{Brightness of light lines})}$$

then these three density differences give $C = 0.97, 0.44$ and 0.21 respectively.



Fig. 4. Separated sections of authors' test pattern (see Fig. 3).

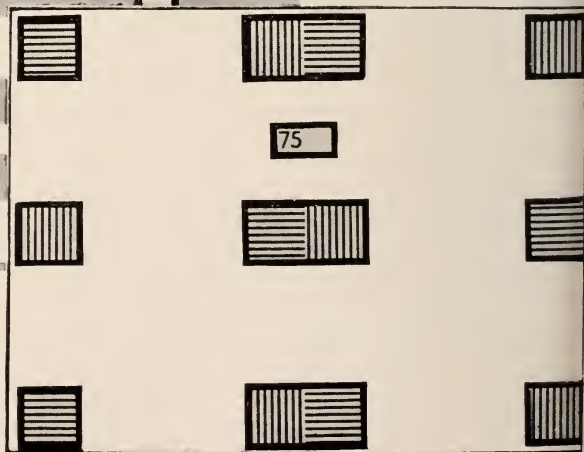
(a) and (c) are supported on glass. (b) is on a celluloid base and is sandwiched between (a) and (c). (a) faces the observer.

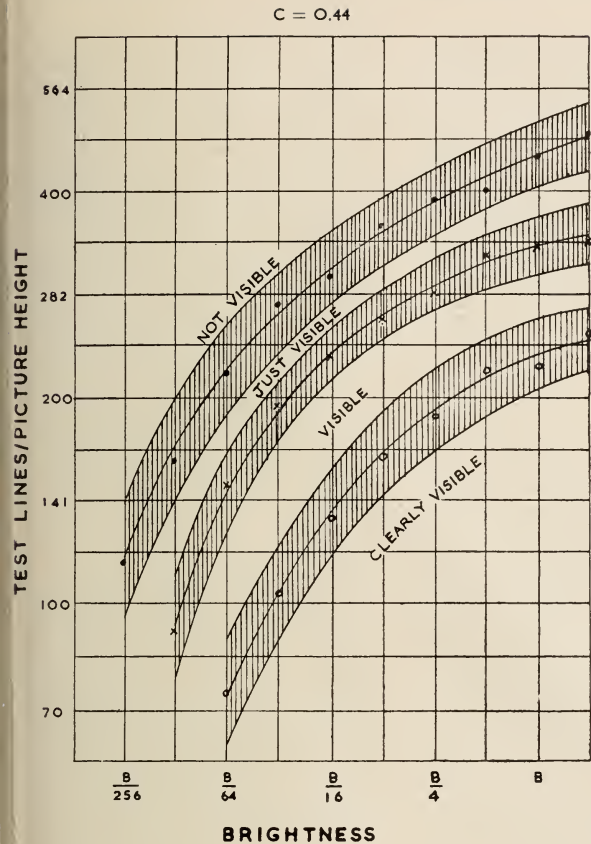
(a) (Bottom right). Resolution/contrast component.

(c) (Top left). Brightness component.

(b) (Centre). Constant brightness adapting surround field of neutral density 0.8, containing fixed reference step wedge, graded horizontal and vertical resolution patterns, and numbering apertures.

Fixed step wedge densities:—0.0, 0.6, 1.2, 1.8, 2.4, 3.0. Fixed resolution patterns: 110-225 test lines/picture height.





Viewing Distance

Measurements were made at three viewing distances which were fixed multiples of the picture height. The first was "close inspection" of the reproduced picture in which the limitations of the observers' vision were largely eliminated thus giving the best estimate of the absolute system performance. The other two viewing distances were at 4 times and 8 times the picture height, and the results obtained with these were obviously a combination of the performance of the reproducing system and the observers' vision. Four times the picture height is considered to be the optimum distance for viewing a motion picture and eight times the picture height has in the authors' experience never been exceeded at the back of any of the cinema theatres visited in the course of the investigation. Data obtained at these three viewing distances are labelled respectively $O \times H$,

Fig. 5. Typical Plot of Observer Data for one value of Contrast and Viewing Distance showing Visibility Zones and Limits of Accuracy.

Direct Viewing. Highlight Brightness $B = 10$ foot-lamberts. Picture size— $19.2'' \times 14.4''$. $4 \times H$; 10 Observers; $N \bullet J \times V \circ C$.

Vertical Test Lines. (Shaded areas show 0.95 Probability Limits for mean of 10 Observers.)

$4 \times H$, and $8 \times H$ in the accompanying figures and tables. Some further data were obtained where negatives and prints were obtainable. These were examined under low magnification with adequate lighting, as is common practice in carrying out limiting resolution tests.

Visibility Criteria

Four degrees of visibility were soon agreed by the observer teams. These were named respectively "Not Visible" (N); "Just Visible" (J); "Visible" (V); and "Clearly Visible" (C). Results of the observer tests have generally been plotted as families of curves of which Figs. 9 and 10 are typical. In the three vertical columns curves for the three contrasts are plotted, and in the horizontal rows the three viewing distances. The dividing lines separating the four degrees of visibility form the three curves plotted in each individual graph, as shown in detail in Fig. 5. These three curves have been designated N/J, J/V, and V/C respectively. The shaded zones show typical limits of expected accuracy obtained from the spread in the ten observers' results. Where available the low magnification examination of negatives and positives has been plotted in the same graphs as the close inspection ($O \times H$) data, and it should be noted that all these consist only of the Not Visible/Just Visible (N/J) curves, as in these cases the absolute limit of performance of the system was the sole interest.

Each graph has a horizontal Brightness and vertical Resolution axis. It must be emphasized that the brightnesses plotted are those of the original and not of the reproduction by the system. The latter are given by the transfer characteristics in Fig. 11, and whilst these are independent of the visibility data,

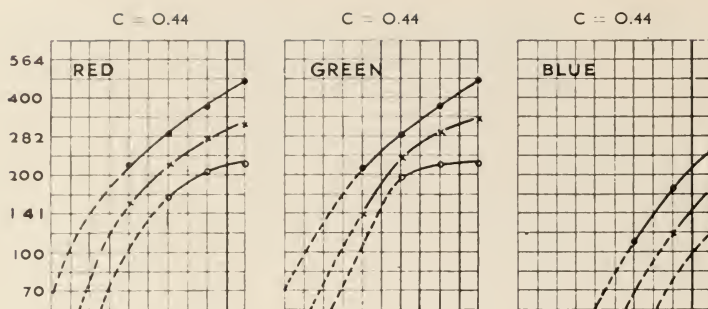
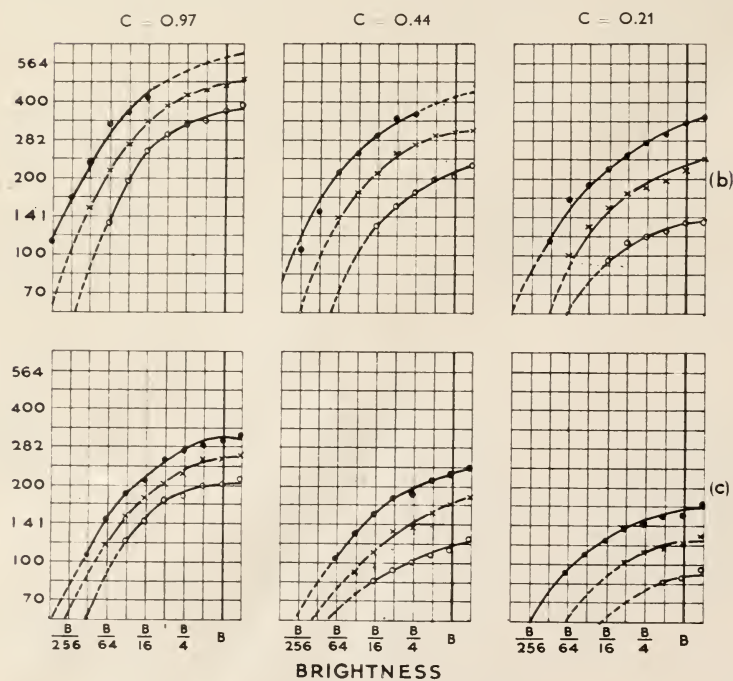


Fig. 7. TRI-COLOUR ADDITIVE SYSTEM.

Highlight Brightness Red 4.65 ft. lamberts, Green 4.65 ft. - lamberts, Blue 0.70 ft. lamberts. $4 \times H$, 3 Observers. $N \bullet J \star V \phi C$

TEST LINES/PICTURE HEIGHT



BRIGHTNESS

DIRECT VIEWING.

Highlight Brightness $B = 10$ ft.-lamberts. Picture size = 19.2 ins. by 14.4 ins.

Fig. 6. (b) $4 \times H$. 10 Obs. $N \bullet J \star V \phi C$ } January, 1949.
(c) $8 \times H$. 10 Obs. $N \bullet J \star V \phi C$ }

AVERAGE HORIZONTAL/VERTICAL TEST LINES.

the converse is not true. The degree of visibility is very dependent on the transfer characteristic, as discussed below.

The visibility data given by Table I and Figs. 6-10 can be interpreted as showing how much of the original subject matter is rendered visible in the reproduction by the system.

Should the distortions of the reproducing system result in either an increase in relative brightness, or in detail contrast on any part of the characteristic, it may be possible to see more in the reproduction than by direct inspection of the original. Such an effect was actually observed in the tests made on the quarter plate camera.

Before discussing the results obtained the following notes regarding the different systems tested may be of interest.

Direct Viewing

By allowing the viewing team to observe the test patterns direct it was possible to obtain the characteristic of the average eye over the full range of the variables. The highlight brightness chosen—10 foot-lamberts—was considered to be representative of normal motion picture and theatre television reproduction. Some ambient light was provided by directing a lamp on to the wall of the room behind the test patterns. There has been a recent tendency to consider picture highlight brightnesses as high as 100 foot-lamberts for home television, particularly in the U.S.A. This will necessitate higher standards of picture quality, particularly with regard to

noise (graininess). 35mm. projection has been criticized in this respect for brightness of 15-20 foot-lamberts.⁷ The limit of visual acuity with a high contrast test object was found to be 595 test lines per picture height at a viewing distance of $4 \times H$ (Fig. 6). This corresponds to a visual

acuity of 1.4 minutes of arc which is in satisfactory agreement with classical data. Fig. 7 shows one set of results for the three primary colours, red, green, and blue. Note the considerable drop in resolving power to blue,⁸ which is an indication of the economies to be effected in the video channel required for colour television.

Quarter Plate Photographs

This size of camera was chosen as an example of direct photography, as it was the smallest size which could be viewed directly as a contact print, thereby avoiding further possible degradation of quality by enlarging. Four times the picture height (13 inches), is sufficiently beyond the "near point" of vision (10 inches) to be comfortably accommodated by the eye (with glasses if worn). Of all the systems tested this one reproduced the greatest number of test objects. Under low magnification, all except two were reproduced by the negative! It also gave the best picture quality.

The operating conditions were 1/10th second exposure at f/4.5 with a scene highlight brightness of 325 foot-lamberts, using P300 plates. The observed picture size was 4 inches by 3 inches; viewing highlight brightness was 8 foot-lamberts. This system was also tested with the viewing highlight brightness increased to 80 foot-lamberts, showing a corresponding increase in visibility.

The transfer characteristic for this system is shown in Fig. 11. For the detailed visibility data reference should be made to the earlier publication.

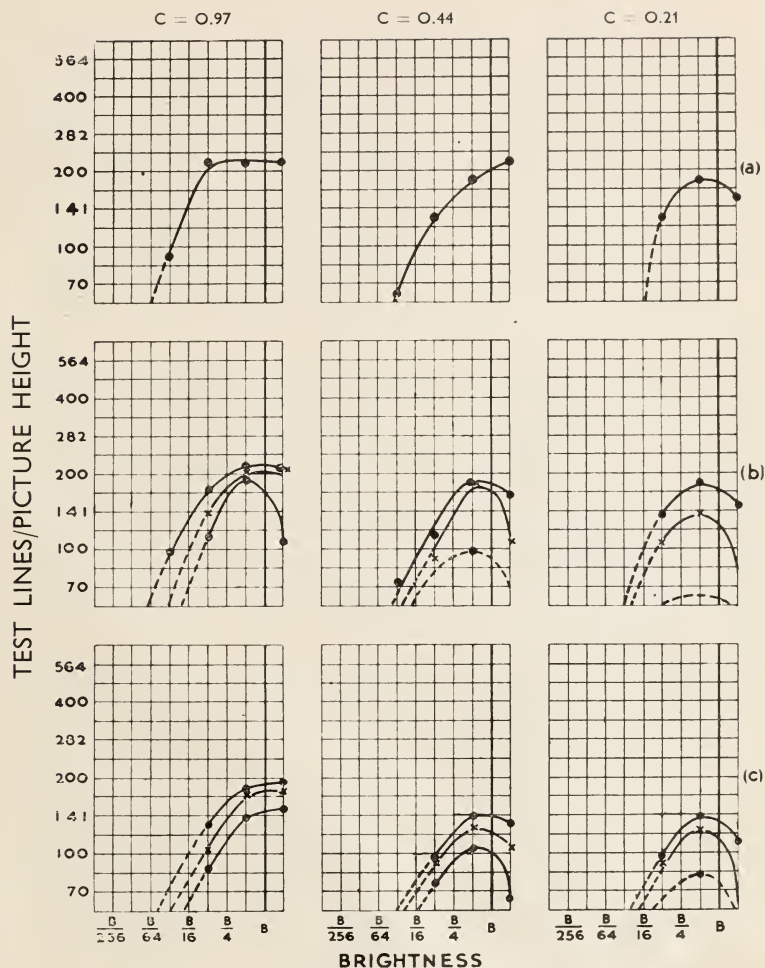


Fig. 8. 405-LINE 50 FIELDS SEC. 2/1 INTERLACE FLYING SPOT C.R.T. FILM SCANNER TRANSMITTED BY LINE TO 20" MONITOR C.R.T.

Transmission of test film Fig. 9a.

Receiver Highlight Brightness = 30 ft. lamberts.

Picture size = 15" × 11.25"

- (a) O × H, 1 Observer. N ● J
 (b) 4 × H, 6 Observers. N ● J * V ○ C.
 (c) 8 × H, 6 Observers. N ● J * V ○ C.

VERTICAL TEST LINES

Television Systems

Two television systems were tested, a flying spot 405-line film scanner and a 625-line Image Orthicon camera chain (1948 vintage). The former was further tested with and without spot wobble, in both cases of course using the 35mm. positive film made for the motion picture experiment described overleaf. The output of this flying spot scanner was displayed on a high quality 20-inch television monitor, and although limited to 405-line

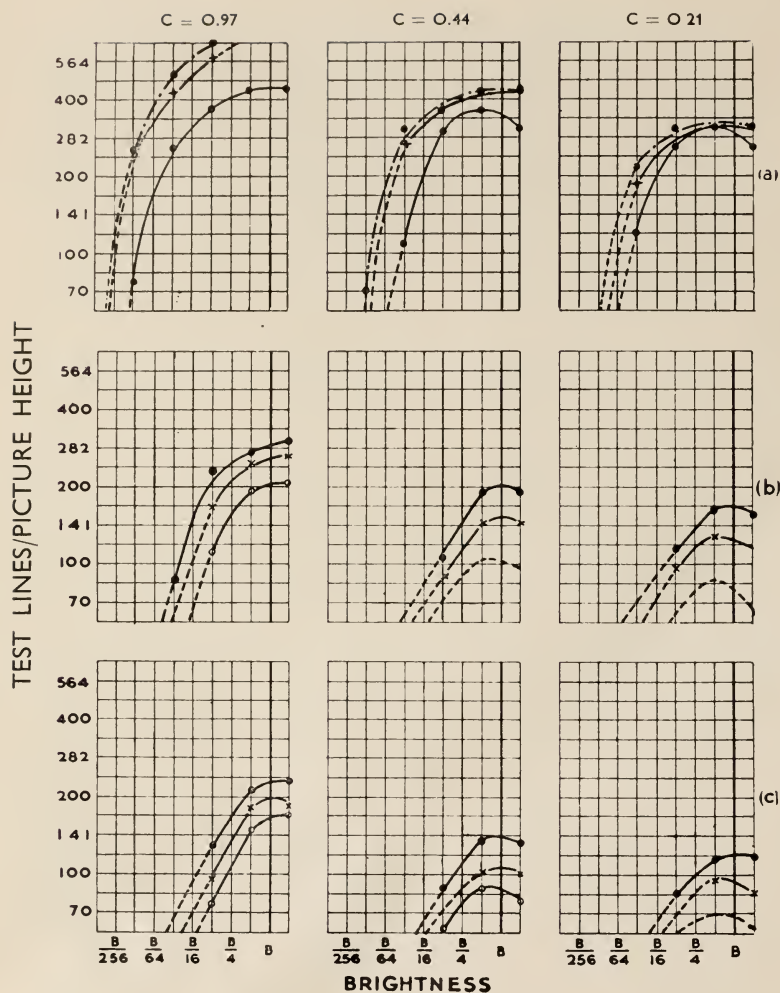


Fig. 9. 35 mm. MOTION PICTURE FILM.

50 mm. Tessar lens, unbloomed, $f/3.5$ at $f/4$ Plus X negative; 1302 positive. Highlight B at camera=160 ft.-lbs. Printer light 10. Picture size $0.825'' \times 0.600''$. 24 frames/sec. Exposure $1/48$ sec.

LOW MAGNIFICATION EXAMINATION N/J. (a) ---●--- Negative; ---+--- Positive.

THEATRE PROJECTION. Screen $18' \times 14'$. Highlight 4 ft.-lbs. Feb., 1949
(a) ---●--- O x H, 1 Obs. N/J, (b) and (c) 4 x H and 8 x H, 12 Obs
N/J x V C.

AVERAGE HORIZONTAL/VERTICAL TEST LINES.

standards it undoubtedly gave the highest quality television picture available at that time, and probably even to-day. The picture size displayed was 15 inches by 11.25 inches and the picture highlight was 30 foot-lamberts. The Image Orthicon was operated at $f/5.6$ and a scene highlight brightness of 50 foot-lamberts. The picture displayed

was $13\frac{1}{2}$ inches by 10 inches with a highlight brightness of 5 foot-lamberts.

In the case of television systems, differentiation was of course made between horizontal and vertical resolution in the tests and the results are given separately for the 405-line telecine tests in Table I. Fig. 8 shows only the horizontal resolution. The original curves for both vertical and horizontal resolution and the 625-line Image Orthicon data are given in the earlier publication.

In assessing vertical resolution, i.e. with horizontal lines in the test objects, spurious patterns were frequently observed due to "beating" with the scanning lines. These were noted by the observers, and in the subsequent analysis were counted as "Not Visible."

The use of "spot wobble" in the 405-line system reduced the vertical resolution seen at four times the picture height by about 10 per cent. This appeared to be a small price to pay for the noticeable improvement in picture quality obtained due to the elimination of line crawling and line break-up. In the present experiments the spot wobble consisted of a 10 Mc/s vertical oscillation of

adjustable amplitude applied to the scanning beam. By suitable visual adjustment of this amplitude, the "lininess" of a single field of the scan could be made practically indistinguishable from a pair of interlaced fields, due to the double humped brightness distribution produced by the sinusoidal oscillation as shown in Fig. 12.

35mm. Motion Pictures

Careful preliminary experiments were carried out to check focus and exposure using Plus X negative. The Standard Picture was graded at printer light 10, with a highlight of 160 foot-lamberts, 24 pictures/second and lens aperture $f/4$. This was considered to be representative of normal film studio practice, corresponding to a scene illumination of 115ft. candles at $f/2.8$ (assuming 70 per cent reflection for high lights). The viewing conditions were 4 foot-lamberts highlight brightness on an 18ft. by 14ft. screen. The results are given in Table I and Fig. 9, and by extrapolation it can be seen that for a high contrast test object, the maximum resolution in the centre of the negative, under low magnification, was of the order of 800 test lines per picture height. This is equivalent to 53 lines per millimetre and agrees well with the manufacturer's claim of 55 lines per millimetre for this film stock. Some preliminary data were collected for resolution at the edges and in the corners of the picture.

16mm. Motion Pictures

The experiments have now been extended to 16mm. film projection. This may be obtained by direct reversal of the film shot in the camera, by a print from an orthodox 16mm. negative, or by a reduction print obtained from a 35mm. negative. It has long been known that extremely satisfying results can be obtained by reversal, but this process is not favoured where copies are required. On the other hand, reduction printing is the

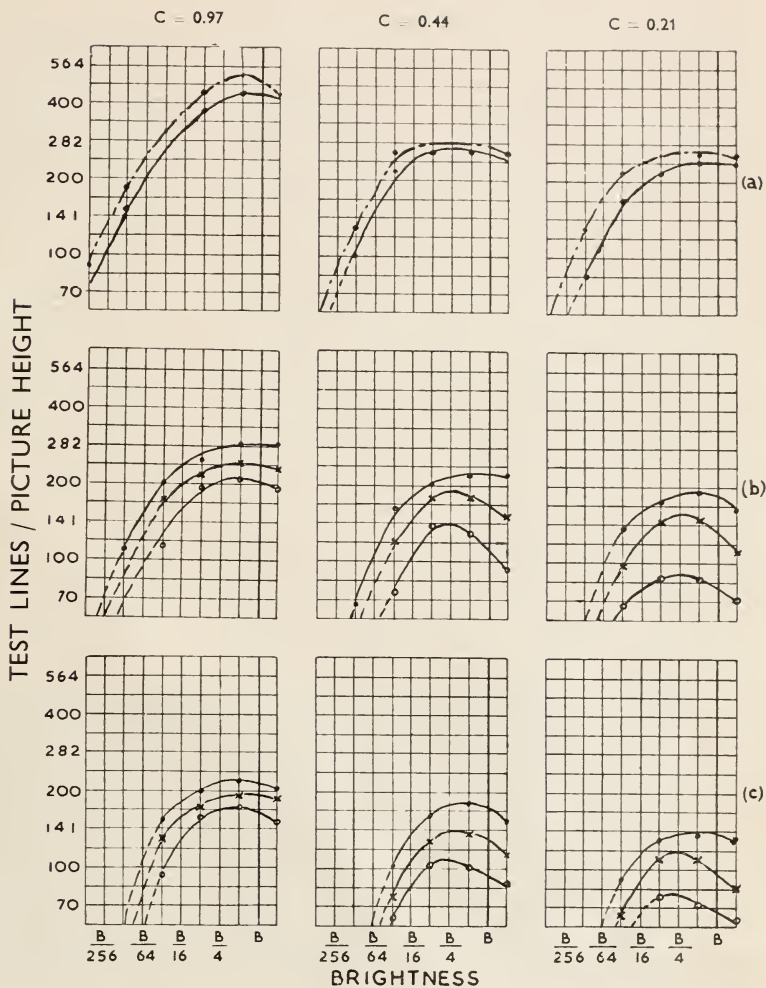







Fig. 10. 16mm. REVERSAL MOTION PICTURE FILM.

50mm. Kodak lens, unbloomed, $f/1.6$ at $f/4$. Super X reversal stock. Highlight B at camera = 325 ft.-lbs. Film processed by makers without second exposure compensation. Picture size $0.380" \times 0.284"$, 16 frames/sec. Exposure 1/32 sec. LOW MAGNIFICATION EXAMINATION (a)  (b)  N ϕ J.
PROJECTION on to Screen $20" \times 16"$. Highlight 6.5 ft.-lbs. (a)  (b)  $0 \times H$, 1 Obs. N ϕ J. (b) and (c) $4 \times H$ and $8 \times H$, 10 Obs. N ϕ J.  C.

AVERAGE HORIZONTAL/VERTICAL TEST LINES.

obvious procedure when so many originals are in the wider gauge. Unfortunately the quality obtained from reduction printing has not been of a very high order.

In the reversal method there is very little control over the result once the material has been exposed in the camera. Although some variation in final density may be obtained by careful adjustment of the second

exposure, the allowable latitude is considerably less than that with the negative/positive process. In the present experiment second exposure "compensation" was dispensed with by taking care to obtain correct initial exposure. The test film was made on Super X using a Cine Kodak Special camera and a Kodak 50mm. f/1.6 lens. Initially the standard picture was shot with various lens apertures and brightnesses, and Messrs. Kodak processed the film under standard conditions without compensation. The most satisfactory exposure was chosen by the observers from the resulting positives. The optimum conditions proved to be scene highlight brightness of 325 foot-lamberts, 16 frames per second and a lens aperture of f/4. The projected picture size was 20 inches by 15 inches with a highlight brightness of 6.5 foot-lamberts. Results of the observer tests are given in Fig. 10 and Table I. Brightness wedges shot at the same time were measured and the results are given, with those of all the other systems, in Fig. 11.

A 16mm. negative/positive dupe of this film has been kindly made by Mr. A. Tutchings⁹ of T.R.E. A commercially-produced reduction print of the original 35mm. negative has also been tested. Results of both these experiments are given in Table I. It is feared that in the latter case the reduction printer was out of condition! A more recent 16mm. reduction print, again kindly produced by Mr. Tutchings, has not yet been fully tested, but some preliminary figures are given in the same table and look more promising.

DISCUSSION OF RESULTS

Immediately following is a brief list of the main conclusions drawn from the results so far obtained. Some of these will be elaborated later, but for the remainder and for more detailed discussion reference should be made to the authors' earlier paper. In considering these results it must be remembered that the measurement of data does not automatically necessitate a correlation between it and the qualities it is desired to assess. On the other hand failure to measure data produces no

progress whatsoever. In visual problems it must also be remembered that one does not see with the eye, but with the "mind's eye." Whilst in some ways it seems reasonable, therefore, to assume that a system which conveys more information to the viewer is a better system, this may not constitute a useful improvement if the additional information is valueless. If one system conveys a *different* set of information from another it may be difficult to express a preference on the basis of measurement alone. These considerations suggest that it may be possible to produce equal enjoyment from a television picture (or a film recorded from a television picture) by totally different standards of performance from those currently in force in the Motion Picture Industry. Bearing in mind these limitations to the interpretation of the above data, the following conclusions seem to be reasonably obvious.

In general the maximum resolution of reproducing systems does not occur at high-light brightnesses, but at half to a quarter of this value. This seems to apply over a large range of viewing conditions (see Table I and Figs. 8, 9 and 10).

Limiting resolution alone, is practically valueless in determining the quality of a picture reproducing system. Comparison of motion picture and television systems on such a basis demands an excessively high number of lines and bandwidth for the television systems. The facts appear to be much more in accord with Fig. 13, which illustrates the probable way in which the resolving powers of television and photographic systems behave for equal picture sharpness at a given viewing distance. Note how high the limiting resolution of the photographic system has to be made in order that it shall compete over the full range of resolution of the television system. The hypothesis of Fig. 13 is supported by the experimental evidence in Fig. 14, which shows how the limiting resolution of 800 test lines/picture height on the 35mm. negative, is reduced to about one-third of this value at normal viewing distance ($4 \times H$) where it is very little better than the curves for the two television

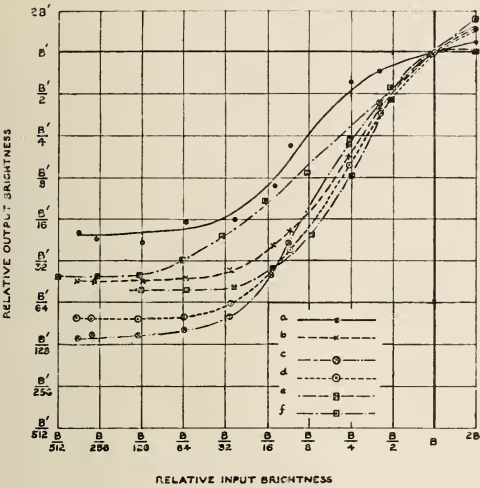


Fig. 11. Collected transfer characteristics :—

	B (Ft.-L.)	B' (Ft.-L.)
(a) Quarter Plate Print	325	8
(b) 35mm. Motion Picture	160	4
(c) 35mm. Motion Picture (Black adapted)	160	4
(d) 405-line Telecine Monitor	160	30
(e) 625-line Image Orthicon Monitor	50	5
(f) 16mm. Reversal Film	325	6.5

systems. The latter show no significant improvement at $O \times H$ instead of rising steeply as do the film systems. In other words, there is no point in reproducing

information which cannot be seen by the average observer at a normal viewing distance.

Correlation of the data with picture quality appears to be greatest in the region of low contrast, $C = 0.21$ or less ; input brightness of the order of a half to one quarter of the highlight brightness ($\frac{B}{2}$ to $\frac{B}{4}$) ; and a viewing distance of four times the picture height. This agrees with the idea that it is the low contrast resolution in a picture which controls the viewers' estimate of its sharpness. If the

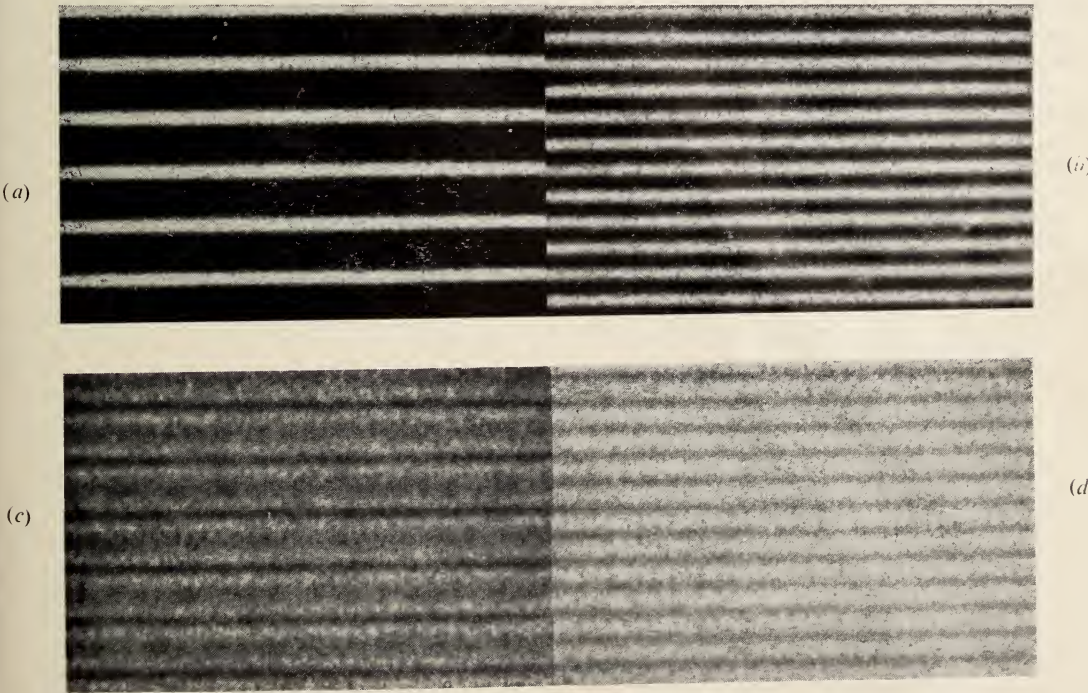


Fig. 12. Photographs of single field and 2/1 interlaced fields with normal scanning and with superimposed spot oscillation.

- (a) Normal scanning. Single field.
- (b) Normal scanning. Interlaced fields.
- (c) Vertical spot oscillation. Single field.
- (d) Vertical spot oscillation. Interlaced fields.

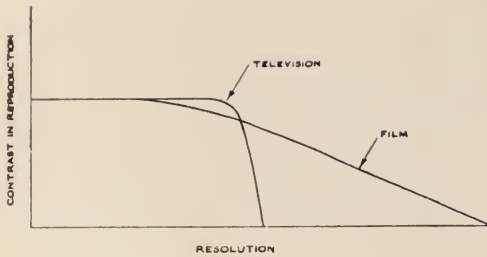


Fig. 13.

effect of high contrast boundaries is ignored therefore, it will be seen from Table II that only 600 lines and 5 Mc/s is required in a well engineered large screen television system to compete with 35mm. motion picture standards. Table II was prepared by extrapolation from the authors' experimental data.

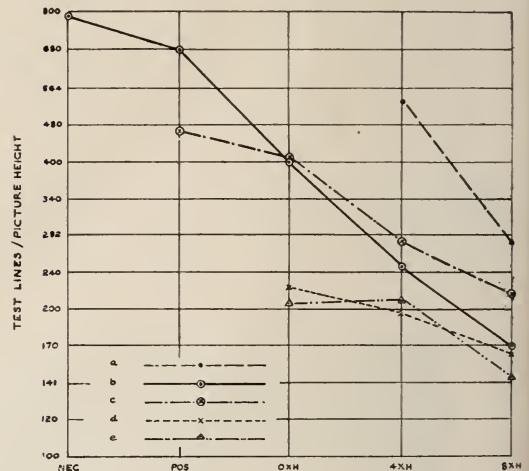
The previous paragraph emphasizes the importance of low contrast test objects. In the later discussion it is shown that this applies particularly in the darker tones where noise (graininess) is likely to be the main limitation. The use of criteria of greater visibility has the same effect, but is not so easily carried out in practice. In this connection it is unfortunate that the recently proposed Motion Picture Test Pattern¹⁰ does not include some low contrast portions.

Normal viewing of 35mm. film projection gives about half the resolution obtained by direct inspection of the original subject matter at the same brightness, over a wide range of

detail, brightness, and contrast (see Table Ib, and Fig. 14).

The corner resolution of 35mm. film projection is only about half as good as the centre of the field of view.

16mm. reversal film is capable of giving results comparable with 35mm. except of course in projected picture size for the same brightness. Considerable losses are experienced in reduction printing from 35mm. film

Fig. 14. Centre of Field, $B/4$, $C=0.97$, N/J

- (a) Human Eye
- (b) 35mm. Film (Neg./Pos.)
- (c) 16mm. Film (Reversal)
- (d) Flying Spot Telecine (35mm.)
- (e) Direct Television (Image Orthicon)

TABLE II

Viewing Distance	Contrast C			0.97			0.44			0.21		
	Visibility Criterion			N/J	J/V	V/C	N/J	J/V	V/C	N/J	J/V	V/C
$4 \times H$	Equivalent total number of scanning lines ...			810	820	705	565	465	430	520	515	585
	Equivalent video bandwidth Mc/s ...			7.9	9.7	6.6	5.2	3.1	3.1	2.9	3.7	—
$8 \times H$	Equivalent total number of scanning lines ...			520	460	430	415	375	355	380	375	415
	Equivalent video bandwidth Mc/s ...			3.7	3.2	2.7	2.5	2.4	2.4	2.2	2.2	—

unless great care is taken in the processing, particularly in the quality and in the adjustment of the lens in the reduction printer (see Table I, and Figs. 9 and 10).

Small pictures appear sharper than large ones for the same proportionate viewing distance due, it is believed, to some peculiarity of normal vision.

As an overall system characteristic, constant gamma is a myth. The input/output brightness characteristics of all the systems tested had no straight portion, as shown in Fig. 11. Gamma could only be defined as a point value on the curves.

The low brightness range arising from the "S" shaped characteristic obtained in practice is not so detrimental to picture quality as might be thought at first sight. Reduction in contrast occurring at low input brightness can be partly, or on occasions more than, compensated by the resulting increase in brightness in the reproduction, thereby making use of the eye's ability to distinguish lower contrasts at higher brightnesses, as illustrated by Fig. 15. Such an improvement in the reproduction occurred in the test with the quarter plate prints, where certain test objects in the middle of the brightness range were more clearly visible on the prints than in the original test patterns under equal viewing conditions. The quarter plate prints were also judged to be the best for picture quality of all the systems tested, despite having by far the smallest tone range (20/1) available in the reproduction (Fig. 11). It seems highly probable that experienced cameramen intuitively light their pictures so as to bring the maximum amount of information in the original into a range of brightness where it can be reproduced with minimum loss of quality.

An observer team is essential for this type of investigation and it can be deduced from the statistical data available (such as is illustrated in Fig. 5), that an individual observer taken at random cannot read a resolution chart at normal viewing distance with an

accuracy better than ± 40 per cent of the average observer.

A single test pattern embodying simultaneous variations of Brightness, Resolution, and Contrast can be constructed, as for example the one shown in Fig. 16. This covers the complete range of the variables used in the present experiments. This procedure however, has all the disadvantages discussed earlier for single composite test charts. In particular it relies on uniform response over the picture area, and the adjacent test objects create local adapting fields for each other. Such a test object must therefore be used with great caution if at all.

Sensitivity and Fundamental Performance Factor of Films and Pick-up Tubes.

The complete set of data obtained for any

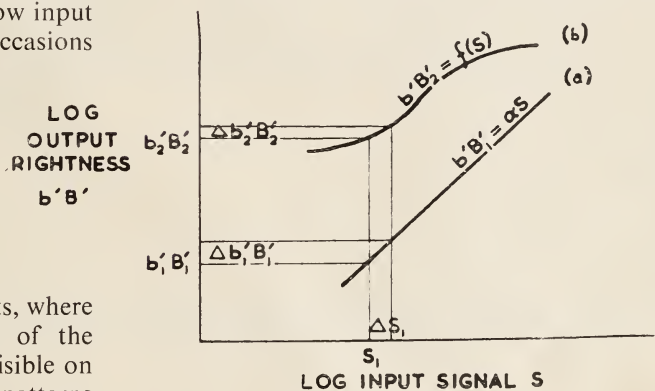


Fig. 15. Diagram showing effect of (a) linear, and (b) arbitrary transfer characteristics on reproduction of the same input signal.

given system, such as for example the 21 curves for the three viewing distances $O \times H$, $4 \times H$, and $8 \times H$, obtained for 35mm. film in Fig. 9, has proved amenable to analysis as a result of the important fundamental approach proposed by Rose.¹¹ Reduced to its simplest terms, he shows that if a system is eventually and finally limited by purely random fluctuations occurring in it—"noise" in the case of television for example—and this fluctuation is proportional to the square root of its average value at any instant, then there is a simple relationship between resolution, contrast, brightness, and visibility.

From his theory it can be deduced that on the log Input-Brightness/log Resolving-Power graphs of Figs. 6-10, a constant degree of visibility (corresponding to a given probability of seeing the test object) at a given contrast will correspond to a straight line at a fixed slope on the graph. The position of this line will depend on (a) the degree of randomness (noise) in the system, (b) the contrast of the test object used, and (c) the visibility criterion. The higher the noise content of the signal, the lower the contrast of the test object, or the more certain the visibility criterion used (the higher the probability of seeing the test object), the lower will be the resolving power attainable at any given value of brightness, i.e. the further to the right on the graph will the limit line lie. It is shown in the previous publication that with this approach, a tolerably good explanation can be given of the behaviour of the three dimensional surface resulting from a constant visibility criterion and viewing distance plotted in terms of the three axes Brightness, Resolution and Contrast.

The principle of this method of approach is illustrated in Fig. 17 which shows two hypothetical constant visibility curves resulting from two positions of the "noise" limit line, corresponding to a low and a high noise content in the signal, other conditions being unchanged. It should be noted that this diagram applies to a given value of contrast and is therefore effectively a two-dimensional cross section of the three dimensional diagram referred to, perpendicular to the contrast axis.

Fig. 17 shows that there are four limit lines to the constant visibility curve for a given value of contrast (these of course become four limit surfaces to the constant visibility surface when contrast is also allowed to vary). These limits are the maximum and minimum input brightness determined by the knee and toe of the S-shaped transfer characteristic, the maximum resolution set by the size of the resolving element used in the system, and the noise limit already mentioned. In cinematography the maximum input brightness corresponds to clear film on the positive. In

a television camera tube it corresponds to the maximum potential which the target will sustain. Similarly the minimum input brightness corresponds to unexposed negative coupled with the limit set to tone perception by the background graininess of the positive emulsion; in television it corresponds to the "standing noise" present in the camera tube when no light is falling on it. The maximum resolution limit* is set by the average grain size in the case of a photographic emulsion and by the size of the scanning aperture in a television tube. Fig. 17 shows the interaction of these limits on the constant visibility curve. In particular it shows the effect of low and high noise content, the other three limits remaining constant. Remembering that the same type of change in the visibility curve would be expected from a lower contrast test object, or a higher degree of visibility as from a higher noise limit, it will be seen by inspection that the experimental curves of Figs. 6-10 are entirely in accord with this conception. From this it will be seen that if a high contrast test object is used with a low visibility criterion (N/J for example), the resulting curve will tend to be like "a" in Fig. 17. This curve is relatively unaffected by the noise limit which is overshadowed by the minimum input brightness limit and the maximum resolution limit. The curve does, however, closely approach the maximum resolving power of the system, but at a brightness less than the highlight brightness B . If a low contrast test object is used and/or a high visibility criterion (V/C for example), then the visibility curve will be more like "b" in Fig. 17. This does not approach the limit of resolution, but is almost entirely controlled by the noise limit in the lower brightness range. For determining the limiting resolution it is therefore preferable to use a high contrast test object and a limiting visibility criterion—which of course has been common practice. On the other hand for determining the fundamental limitation due to true randomness (noise, grain) in the system,

* Note that in this connection the effect of optical elements are considered to be sufficiently perfect to be neglected.

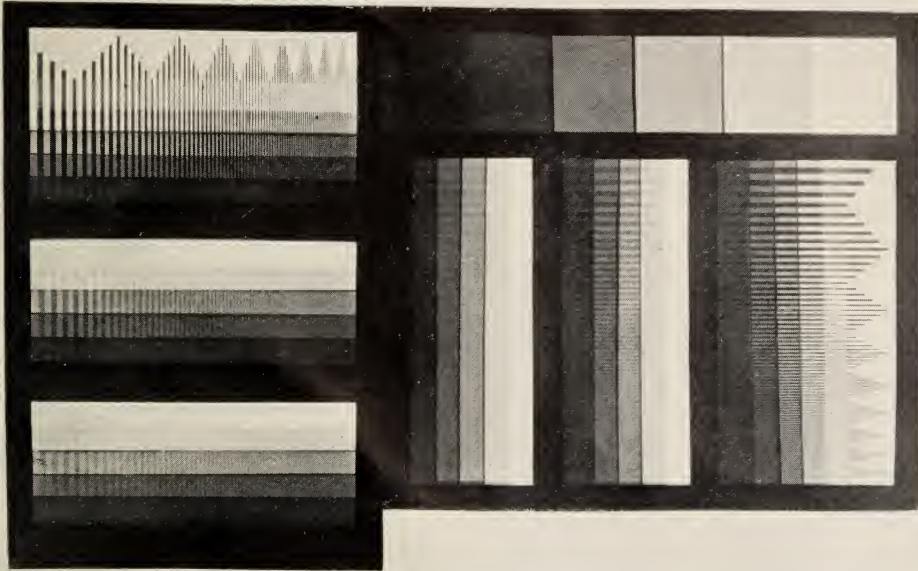
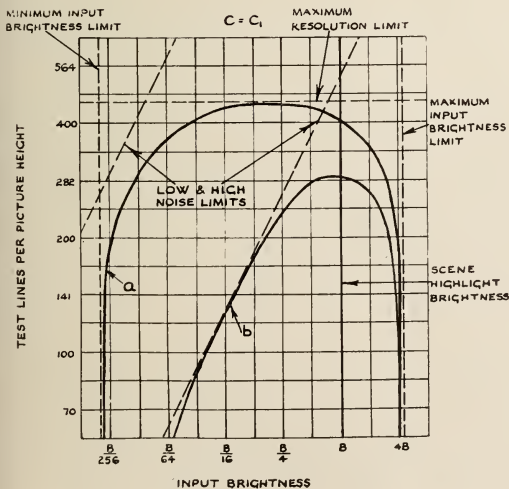


Fig. 16. Single test object incorporating the combined variable brightness, resolution and contrast over the range used in the individual test patterns (Figs. 3, 4).



a low contrast test object should be used and/or a high degree of visibility. In fact, this type of test appears to offer better correlation with observed picture quality, although it is unlikely that a single measurement on a system will give all the information necessary to assess it, when families of curves as widely different as those shown in Figs. 6-10 are obtained.

Coming now to considerations of Sensitivity and Fundamental Performance Factors for a given system, it will be obvious from Fig. 17

Fig. 17. Hypothetical performance curves for a given visibility criterion, viewing conditions, and contrast (C_1), showing the effect of the maximum resolution limit, maximum and minimum input brightness limits, and two values of noise limit.

that the actual value of B is the determining factor for Sensitivity. This has to be corrected for lens aperture and image size to eliminate depth of focus as a variable between systems, and it may be reduced to the total light flux incident on the camera target per picture exposure. This can be expressed in terms of the number of light quanta (Q_p) incident on the target per picture. Comparison of a number of systems on this basis is made in Fig. 18. The relative Sensitivities are given by the values of Q_p for the input highlight, indicated by the "B" arrows. The Fundamental Performance Factor in terms of the ultimate randomness or noise in the system is indicated by the relative positions of the tangent lines of appropriate slope. The actual conditions under which this limit is effective in each system is indicated by the "A" arrows. Note the choice of a low value of contrast for this comparison. The appropriate exposure time for a single picture in the various systems is given by t_p , tabulated below the curves. The "Quanticon" referred to is a hypothetical ideal television camera tube, embodying perfection in all its physical processes,¹² which can be approached in performance but never attained.

Finally it must be stressed that whilst the Sensitivity and Fundamental Performance Factor are of great interest, they neither of them appear to exert absolute control of the picture quality attainable. As has already been stated, the quarter plate camera gave better picture quality than any other system tested and this is consistent with curve b in Fig. 18 which attains the highest resolving

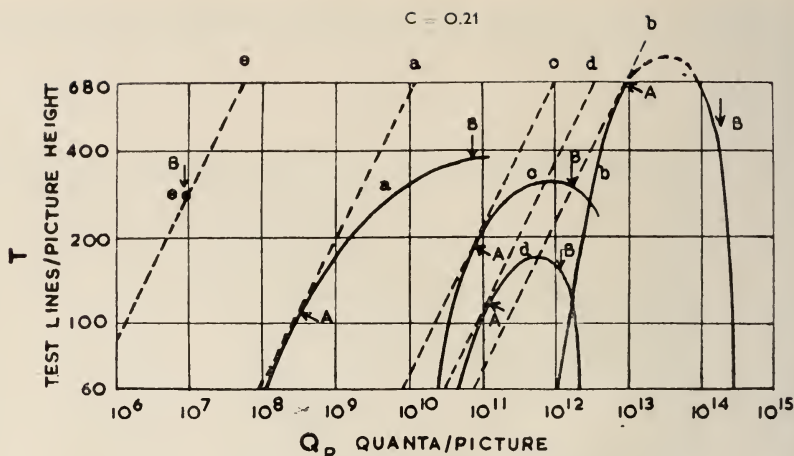


Fig. 18. Relative performance of different picture reproducing systems in terms of resolution and incident radiation on camera target for low contrast test object and N/J criterion.

	Viewing Distance	t_p (secs.)
(a) The Eye	$4 \times H$	1/5
(b) Quarter-plate photograph	$4 \times H$	1/10
(c) 35mm. Motion Picture	$0 \times H$	1/48
(d) Image Orthicon 5655, 625-line	$0 \times H$	1/25
(e) Quanticon, 625-line	—	1/25

power and covers the largest brightness range, whilst it is less Sensitive and has a lower Fundamental Performance Factor than either the Film or the Television camera (c and d).

Recording Television Pictures.

The application of the above work to a problem of immediate interest, the recording of television images, will now be briefly considered. It is not proposed to discuss the problem of recording broadcast television as such. This involves the major problem of recording the whole of two interlaced fields accurately. In the case of television cameras used in film studios for remote recording of pictures, however, sequential scanning is used and this problem disappears. The remaining factors relating to picture quality are then common to both systems and will be discussed here.

The progressive degradation in picture quality through the various stages of the processing of a picture has already been pointed out. For example, Fig. 14 shows that with 35mm. film the stages negative—

positive—projection—viewing reduce the limiting resolution from 800 test lines per picture height to about one-third of this value. Again, Table I shows how reduction printing of 16mm. film from 35mm. negatives can destroy the quality. It is of interest, therefore, to compare the successive processes in film, television, and television recording

systems as illustrated in Table III. Note how the Instantaneous Television Projection System (Column B) scores over the Standard Motion Picture (Column A) by having six fewer processes to degrade the picture quality. The real limitation here is the quality of the Link (Item 15), which for direct cinema television would have to be of the

TABLE III
SUCCESSIVE STAGES IN THE REPRODUCTION OF MOTION PICTURES AND
LARGE SCREEN TELEVISION PICTURES

	A.—Standard Motion Picture.	B.—Instantaneous Television Projection.	C.—Film Recorded via Television Camera.	D.—Future True Television Recording.
1.	Illumination	Illumination	Illumination	Illumination
2.	Scene	Scene	Scene	Scene
3.	Film Camera	Television Camera	Television Camera	Television Camera
4.	Pan. negative	Photocathode	Photocathode	Photocathode
5.	Latent image	Charged target	Charged target	Charged target
6.	Developing	Scanning target	Scanning target	Scanning target
7.	Edit separate takes	Edit continuously throughout programme	Edit continuously for several minutes	Edit continuously for several minutes
8.	Printing	Amplifying	Amplifying	Amplifying
9.	Lavender Print	—	—	—
10.	Develop	—	—	—
11.	Printing	—	†Bright Television Pictures	—
12.	†Dupe negatives	—	†Dupe negatives	†Signal Recordings
13.	Developing	—	Developing	Re-scanning
14.	Printing	—	Printing	Amplifying
15.	*Release prints	‡*Television Links	*Release prints	*Release Recordings
16.	Developing	*Television Reception	Developing	*Re-scanning
17.	*Film Projection	*Television Projection	*Film Projection	*Television Projection
Steps saved over A	—	6	2	3

† Multiple picture outlets.

* Of the order of 1 per theatre.

‡ These channels will probably restrict picture quality compared with high quality closed circuit equipment used in C and D.

NOTE.—In 4 quality has to be balanced against speed, i.e. Illumination.

In 9 and 12 low cost, fine grain, non-panchromatic materials can be used.

required bandwidth and sufficiently free from interference and noise. Making films via a Television camera (Column C) also shows a slight advantage in this direction which is worth noting. Column D is a glimpse into the future when film projectors have become obsolete in cinema theatres and have been replaced completely by television projectors capable of reproducing large screen pictures of acceptable quality either by radio reception or from a locally reproduced recording of unspecified type.

Turning now to the question of the quality of the picture and its recording, it seems obvious from Figs. 13 and 14 and Table II that, even allowing for the degradation inevitably produced in the recording, the choice of standards for a television system designed to compare with present motion picture quality, will be nearer 600 lines than 1,200. Furthermore at 600 line definition, improvements in the noise content of the

signal and in the shape of the transfer characteristic curve, have far more effect on picture quality than a further increase in maximum resolution. The excellent pictures obtained even on 405 lines from a noise free gamma corrected flying spot film scanner substantiate this argument.

Acknowledgments.

The Authors wish to express their thanks to Marconi's Wireless Telegraph Co. Ltd. and Cinema-Television Ltd. for permission to publish the results of this work ; to Denham Laboratories Ltd., and the Research Laboratories of Messrs. Kodak Ltd. for invaluable guidance, and to Messrs. Ilford Ltd. for the standard picture. Thanks are also due to Mr. A. Tutchings of T.R.E. Film Unit for his great interest and help in making additional 16mm. prints, and to all colleagues and organizations who have freely advised and assisted.

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THE LABORATORY CONTROL OF STRIPPING TRIPACKS

P. Jenkins, A.R.P.S. (Member)[†] and G. W. Ashton A.R.P.S. (Member)[‡]

An addendum to "Separation Negatives and Positives for Colour Films"¹

OVER a period of some years the use of monopacks, the emulsion layers of which can be stripped apart or otherwise handled separately, have been proposed by a number of inventors. Such materials would have the advantages of monopacks which are colour developed in that they could be exposed in black and white cameras without difficulty, whilst at the same time they would give three silver separation negatives directly and thus offer the three-strip camera serious competition. The stripping tripack is in effect a linking material between the two systems of photographing a motion picture in colour which are currently in use. Such tripacks can be conveniently grouped into two types—those which are stripped after processing and those stripped before.

A monopack, the layers of which are stripped apart after they have been developed, has the prime advantage that the stripping operation can be conducted in the light. But this advantage is offset by the difficulties of processing the three layers as a pack without mutual interference effects; in addition it dispenses with one of the most important controls which is available when a stripping material is used—the possibility of processing the three layers independently. Hence current attention is being paid only to films of the pre-development stripping type.

The first material of this second type to approach the stage of practical use is that which was described by John G. Capstaff² and which is being coated by Eastman Kodak. Film of this type is, it is believed, being currently tested by both Technicolor³ and Twentieth Century-Fox in Hollywood.

The sensitometric control of such a monopack would seem to offer no particular prob-

lems; a camera gamma would need to be plotted for each layer using the method described in the original paper by the authors for colour developed monopacks.

Whatever method is chosen the use of camera gamma charts provides the proper control which is essential for monopack working and enables any subsequent contrast or density corrections to the individual layers to be worked out and applied easily. Naturally, just as with the three-strip camera and normal monopack, the lily and the register and resolution chart are also used to provide the appropriate control information.

The real difficulties with a stripping monopack are all on the purely mechanical side. The two top layers must be transferred to their new supports in total darkness and within the same tolerances for register as were described for three-strip cameras. As with the negatives from the three-strip camera, two of the negatives are laterally inverted with respect to the third. In this case the red record is the only one which is the right way round and the blue and the green records are reversed due to the transfer operation.

One other small problem also arises. Since this type of monopack is not developed in a dye-coupling developer no advantage can be taken of the considerable intensification which such development systems can confer. Hence the thin emulsions of the stripping monopack tend to give low contrast and this has to be raised to normal levels by either duplication or intensification.

But until some practical experience has been gained with these materials it is difficult to forecast whether these difficulties will prove insuperable or not.

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[†] Ilford Ltd.

[‡] "British Journal of Photography"

TECHNICAL ABSTRACTS

All the periodicals here abstracted may be seen in the Society's Library

RAPID DRYING OF NORMALLY PROCESSED BLACK-AND-WHITE MOTION PICTURE FILM

Miller, F. D., *J. Soc. Mot. Pic. & Tel. Eng.*, 60, Feb. 1953, 85.

The introduction of rapid drying technique for rapidly processed film suggests its possible application for the drying of normally processed motion picture films. Consideration of the drying process seems to indicate that hot impinging air should be the most satisfactory method of commercial practice. Experiments were made on a laboratory machine in which the film passes between two parallel air chambers. Small holes in the sides of the chambers facing the film permit hot air to impinge on both sides of the film. Air temperatures ranging from 125°F to 210°F and air velocities of 2,000 to 6,000 ft./min. were used. Eastman Fine Grain Release Positive Safety Film was dried in 10 secs. on laboratory equipment of this type and Eastman Plus X Panchromatic Negative Safety Film was dried in 16 secs. The physical properties of several films dried in this equipment were quite similar to the properties of conventionally dried films, but this is not true of all types of film. Rapid driers can be extremely compact and their power requirements should be no greater than for conventional driers.

AUTHOR'S ABSTRACT.

FURTHER EXPERIMENTS IN HIGH-SPEED PROCESSING USING TURBULENT FLUIDS.

Katz, L., and Esthimer, W. F., *Ibid*, 105.

The results of an investigation into the effects of turbulence in the rapid processing of photographic film under fixed conditions are described. For test purposes a turbulent processing machine was constructed permitting rapid switching of fluids and elevating of resulting reactions.

AUTHOR'S ABSTRACT.

TELEVISION CAMERA EQUIPMENT OF ADVANCED DESIGN.

Pourciau, L. L., *Ibid*, 166.

The servo mechanisms and mechanical design features of a television camera chain are described. The chain, in order to achieve flexibility and ease of operation, features remote control of lens selection and focus. Centralized functional controls are grouped together for operating convenience. The equipment is compact, light in weight and sturdy for field use, yet meets the high performance standards required in the studio.

AUTHOR'S ABSTRACT.

SPLICING MOTION PICTURE SAFETY FILM WITHOUT CEMENT OR ADHESIVES.

Herzig, L. A., *Ibid*, 181.

A method and apparatus for butt-weld splicing motion picture film, not requiring the usual scraping or cements, are described. The principle is based on a combination of a controlled heat and cooling gradient applied under pressure within a given time cycle, and producing a homogeneous splice. Properties of the film are not affected, as the film is automatically pre-plasticised prior to splicing. The method may be used for all types of safety film.

AUTHOR'S ABSTRACT.

PROPOSED AMERICAN STANDARD, PH 22.75 : A AND B WINDINGS OF 16mm. SINGLE-PERFORATED FILM. *Ibid*, 189.

NEW EQUIPMENT

As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of news items does not constitute an endorsement.

16mm. SOUND-FILM PROJECTOR

The British Thomson-Houston Company's new 16mm. sound-film projector, designated Type 401, supersedes Type 301. While similar in appearance to the 301, the new projector incorporates a number of improvements and changes in design.

There is a considerable reduction of mechanical noise, a saving in weight, a new amplifier giving an

output of 30w, and "Ardoloy" peckers which greatly reduce claw wear.

The 401 gives a light output of over 300 lumens from a 750-watt, 115 volt tungsten lamp with a 2-inch f/1.5 projection lens. Mechanical noise is so reduced that a sound absorbing case around the projector is no longer necessary.

The speaker cabinet, designed as a "ported" baffle with a closed back, to eliminate undesirable reflections of sound from walls behind, is a marked improvement as far as overall efficiency and bass response is concerned.

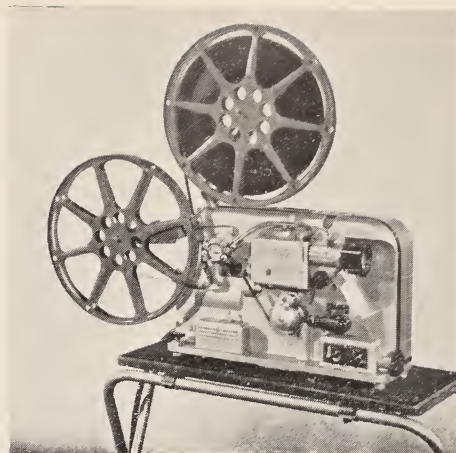
Having removed the amplifier mains transformer from the projector, space is available for larger output valves in "push-pull" with a consequent improvement in the quality of sound. The two EL37 valves give 30w. output with only 5 per cent distortion, and only 1 per cent at 10 watts output.

The twin-speaker console is available to provide adequate power handling when the full 30w. output is required.

Weights of equipment :

Projector	38 lbs.
Projector in carrying case ...	45 lbs.
Speaker unit	23 lbs.
Mains unit	20 lbs.

**The British Thomson-Houston Co. Ltd.
Rugby.**



The 401 16mm. projector

NEW BRITISH STANDARDS

B.S. 1964:1953 — Carbons for Projection and Stage Arcs.

A standard has recently been issued relating to the tolerances on the diameter of high and low intensity plain and copper coated carbons of 6mm. to 14mm. diameter for projection arcs, and plain and copper coated carbons of 10mm. to 25mm. diameter for stage arcs.

It was found that very appreciable difficulties were associated with the preparation of a standard for an article which had more the character of a natural

product than a product of engineering. It was not found practicable to achieve a comprehensive dimensional standard, but it is nevertheless hoped that the present standard, by establishing the tolerances on the diameters of those sizes of carbons which are in common use, will prove of considerable assistance to equipment manufacturers in the design of carbon holders.

1967:1953 — Sprockets for 35mm. Cinematograph Projectors.

A standard for the Dimensions of 35mm. Cinematograph Projector Sprockets, has been prepared in response to a request from the Incorporated Association of Kinematograph Manufacturers.

It relates to 16-tooth intermittent sprockets and to 16-tooth, 24-tooth, and 32-tooth feed and hold-back sprockets. It specifies such dimensions as are essential to achieve accurate engagement with the film, to minimize film wear and damage, and to assist in achieving satisfactory visual performance. It also gives recommended dimensions for the form of the teeth.

In preparing this standard, the requirements of the

corresponding American Standard Z22.35-1947 were reviewed. Such differences as exist between that American Standard and this British Standard are explained by the fact that in the British Standard the dimensions are based on a lower value for the average shrinkage of film than was adopted in 1947 as the basis of the American Standard. In B.S. 1967 it has also been considered preferable to adopt a different method for the dimensioning of the axial distance between the teeth.

The dimensions in this standard are intended to be equally applicable to sprockets for use with both cellulose nitrate film and cellulose acetate film.

Copies of these Standards, which are available for reference in the Society's Library, may be obtained from the Sales Department of the British Standards Institution, 24-30 Gillingham Street, S.W.1. BS 1694: 1953 2s., BS 1967: 1953 2s. 6d.

BOOK REVIEWS

Books reviewed may be seen in the Society's Library

GAS DISCHARGE LAMPS. *Funke, J., and Orange, P. J. Philips Technical Library, Cleaver-Hume Press Ltd., pp. 270.*

This book, written by two well-known workers of long standing in the field of electric discharge lamps, can be highly commended to the scientist, technical worker or general scientific reader who wishes for a full understanding of the operation and characteristics of the various modern types of electric discharge lamp.

Part I deals briefly with the physics of the electric discharge in gases and explains the mechanism of light production and shows how the discharge may be controlled to provide a steady source of light.

Part II is divided into six chapters, each relating to one particular type of discharge lamp. These include sodium lamps, low pressure, high pressure and forced cooled high pressure mercury vapour lamps, fluorescent, stroboscopic and flash discharge lamps. The principles of each lamp, the construction, the characteristics, the type of auxiliary equipment and the most suitable lighting fittings for each are described in detail. Applications of each type are also discussed.

The book is clearly written with photographs and diagrams on almost every page and it is excellently produced on high quality paper.

Few comments other than those of praise are justified. The only major omission is that the compact source mercury vapour lamp, used fairly extensively

in Great Britain, although admittedly less so on the Continent, is dismissed in only one brief section. It is felt that in this otherwise comprehensive work, insufficient space has been devoted to this particular lamp and its applications. It is also thought that the use of the word "gas" in the title is not the best choice.

The subject matter is well supported by a comprehensive bibliography which however consists almost entirely of publications by Continental authors. The bibliography might with advantage have been expanded to include some of the British and American publications in the field of electric discharge lamps.

H. K. BOURNE.

THE WILLIAMSON AMPLIFIER. *Williamson, D. T. M. (2nd Ed.). Iliffe & Sons, Ltd., pp. 40, 3s. 6d.*

A completed collection of the articles on the *Design of a High Quality Amplifier* which Mr. Williamson has contributed to the *Wireless World* during the past five years. The work has been brought up to date by the addition of pre-amplifier circuits and an R.F. feeder, together with information on correction of the units for $3\frac{1}{2}$ r.p.m. discs and high-impedance pick-ups. Recommended to those contemplating or interested in the construction of a 15 watt. high fidelity non-synchronous unit.

L. KNOPP.

THE COUNCIL

Summary of the meetings held on January 7, February 4 and March 4, 1953, at 164 Shaftesbury Avenue, London, W.C.2.

Present (January 7th) : Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), R. J. T. Brown (*Hon. Secretary*), R. E. Pulman (*Hon. Treasurer*), H. S. Hind (*Deputy Vice-President*), S. A. Stevens and D. Ward.

Apologies for absence : Apologies for absence were received from the Past-President and Mr. N. Leever.

Present (February 4th) : Mr. L. Knopp (*President*) in the Chair, and Messrs. B. Honri (*Vice-President*), R. J. T. Brown (*Hon. Secretary*), R. E. Pulman (*Hon. Treasurer*), H. S. Hind (*Deputy Vice-President*), G. J. Craig, F. S. Hawkins, T. W. Howard, N. Leever and S. A. Stevens.

Apology for absence : An apology for absence was received from the Past President.

Present (March 4th) : Mr. L. Knopp (*President*), in the Chair, and Messrs. B. Honri (*Vice-President*), R. J. T. Brown (*Hon. Secretary*), R. E. Pulman (*Hon. Treasurer*), H. S. Hind (*Deputy Vice-President*), A. W. Watkins (*Past President*), G. J. Craig, F. S. Hawkins, N. Leever and S. A. Stevens.

Apologies for absence : Apologies for absence were received from Messrs. T. W. Howard, T. M. C. Lance and D. Ward.

In attendance : Miss J. Poynton (*Secretary*).

R.P.S. Centenary Celebrations.—It is desired to make a contribution to the programme of Centenary Celebrations which is being arranged during 1953 by The Royal Photographic Society. On April 2 and April 22, therefore, Mr. Howard Thomas (Member) will

present a programme entitled "Preview of Tomorrow's Newsreels." Admission for members of either of the Societies will be by ticket only.

1953 Convention.—The programme for the Convention which will take place on Saturday, May 9, 1953, is as follows :

- 12.45 for 1 p.m. Informal Luncheon.
- 3.30 p.m. Ordinary Meeting of the Society.
- 4 p.m. Presentation of Fellows' Certificates and Presidential Address.
- 4.45 p.m. Tea.
- 5.30 p.m. A New Feature Film.

New Grade of Membership.—Steps are being taken to admit to the membership persons who, although not gainfully employed in the industry, are able to produce evidence to the satisfaction of the Council that they have made use of cinematographic processes for professional, scientific, educational or artistic purposes. Such entrants must be either accomplished in the art or technology of cinematography or else seriously desirous of improving their proficiency.

Ministry of Labour and National Service.—A request has been made by the Ministry of Labour and National Service for assistance in defining the technical grades within the film industry. The composition of the Committee appointed to consider the question is : the President (*Chairman*) and the Chairmen of the four Divisions and the representative of the Ministry of Labour.

Three-Dimensional Films.—The view is held that clarification is required of the problems associated with cine-stereo photography and stereoscopic and wide-screen projection. An *ad hoc* Committee has been appointed to investigate the matter and provide guidance both to film producers and cinema proprietors.

B.S.I. Cinematograph Industry Standards Committee.—The Council has submitted nominations for Society representatives to serve on the above Committee. These are Dr. Knopp, Dr. Hawkins and Mr. Hind.

COMMITTEE REPORTS

Membership Committee.—The following are elected :—

Corporate Members

- Reginald William Henocq, W. Vinten, Ltd., 715 North Circular Road, Cricklewood, N.W.2.
- Reginald Martin Moore, Cinematograph Export, Ltd., 715 North Circular Road, Cricklewood, N.W.2.
- Robert Evans, Technical & Scientific Films, Ltd., 53 New Oxford Street, W.C.2.

Percival Walter Alston, Jemerton, Ltd., Parkworth House, 30 City Road, E.C.1.

Guido Marpicati, Instituto Nazionale L.U.C.E., Piazza Cincetta 1, Rome.

Franco Robecchi, Titanus S.A., Via Margutta 54, Rome.

Mario Bottini, CI.MA.BO. S.A., Via Assini 160, Rome.

Piero Cavazzuti, Metro Goldwyn Mayer, S.A.I. 5 Via dei Villini, Rome.

Frank Jessup, G.B. Equipments, Ltd., 37 Mortimer Street, W.1.

Associates

Adeyokun Alexander Fajemisin, Nigerian Film Unit, Lagos, Nigeria.

William McDonald, Ritz Picture House (Sheffield) Ltd., Parson Cross, Sheffield 5.

Thomas Francis McDonald, Manor Picture House, Ltd., Intake, Sheffield.

James Frederic Jarvis, Rex Cinema, Romford, Essex.

Denis John Serretta, Pan-African Film Services (Pty.) Ltd., P.O. Box 9992, 59 Beckett's Building, Johannesburg, S.A.

Eric Herbert Monk, British Broadcasting Corporation, Lime Grove, W.12.

James Thompson, Ritz Cinema, Keighley, West Yorkshire.

Thomas Hugh MacLeod Carpenter, Sound-Services, Ltd., 269 Kingston Road, Merton Park, S.W.19.

Frederick Winn, North Thames Gas Board, 30 Kensington Church Street, W.8.

Students

Hissamud-din Akbar, "Russell House," 11 Bernard Street, W.C.1.

Khurshid Alam, "Russell House," 11 Bernard Street, W.C.1.

Firoz Sarosh, 12 Boltons Court, Old Brompton Road, S.W.5.

Suman Kantilal Parikh, c/o C. F. Patel & Sons, 115 Fleet Street, E.C.4.

Gerald Louis Weinbren, London House, Guilford Street, W.C.1.

The following are transferred from Associateship to Corporate Membership :

Roland Frederick Ebbetts, Metro-Goldwyn Mayer, Ltd., Scotsbridge Mill, Rickmansworth, Herts.

William Jack Carvey, Odeon Cinema, Aylesbury.

The following are transferred from Studentship to Associateship :

Peter Herron, Odeon Cinema, High Street, Gateshead-upon-Tyne 8.

Iqbal Hasan Shahzad, G.B.-Kalee, Ltd., 37-41 Mortimer Street, W.1.

The resignations of 9 Corporate Members, 12 Associates and 2 Students were noted with regret.

The death of one Hon. Fellow, and two Corporate Members were noted with regret.

Report received and adopted.

16mm. Film Division.—The Council has appointed Dr. D. Ward Chairman of the Divisional Committee for the year. Mr. G. H. Sewell has been re-appointed and Mr. J. Masterton has been appointed to the Divisional Committee for two years.

Report received and adopted.

Film Production Division.—The Council has appointed Mr. T. W. Howard Chairman of the Divisional Committee for the year. Mr. H. Harris has been re-appointed and Dr. F. P. Gloyns and Mr. A. Challinor have been appointed to the Divisional Committee for two years.

Consideration is being given to the possibility of instituting an investigation respecting the efficient and economic techniques of film production in the studio and on location with the object of publishing a code of practice.

A recommendation has been submitted to the Education Committee that a course of study on Sound be included in the programme for the 1953/54 Session.

Report received and adopted.

Theatre Division.—The Council has appointed Mr. J. A. Walters Chairman of the Divisional Committee for the forthcoming year. Mr. A. E. Ellis has been re-appointed and Mr. S. A. Stevens and Mr. N. Mole have been appointed to the Divisional Committee for two years.

Report received and adopted.

Television Division.—The Council has appointed Mr. L. C. Jesty Chairman of the Divisional Committee for the year. Mr. W. H. Cheevers, Mr. M. F. Cooper and Mr. S. B. Swingler have been re-appointed to the Divisional Committee for two years.

In the 1953/54 Session it is hoped to include in the programme a further visit to Lime Grove Studios and also a demonstration of a television outside broadcast.

Report received and adopted.

Fellowship Committee.—The Hon. Fellowship of the Society is to be conferred on M. André Debrie and Mr. G. W. Pearson.

The Fellowship of the Society is to be conferred on Mr. G. S. Moore, Mr. Charles Vinten and Dr. Denis Ward.

Report received and adopted.

The proceedings then terminated.

LIBRARY NOTES

To some readers of this *Journal* the words "Standard Specification" may sound the introduction to a slightly tedious, if not altogether boring subject. Yet Standard Specifications need not be dull, while their existence has certainly been of great value to a large number of industries, among them the motion picture industry.

First references to Standard Specifications for the motion picture industry are to be found in the *Transactions of the Society of Motion Picture Engineers*, and indeed standardisation was one of the corner stones upon which that Society was founded. The first motion picture standards, appearing in the July, 1917, *Transactions* of the Society, include specifications for the perforation of film incorporating the Bell Howell perforation which have remained substantially unchanged through 35 years. To-day, a stage has at last been reached where new alternative specifications are closer to adoption, although with so much equipment in use built to the original standard, practical signs of it may still be years away.

For a long time the Society of Motion Picture

Engineers continued as the authoritative source for motion picture standards, until the American Standards Association took over in the U.S.A. Many British Standard Specifications have likewise been published in Great Britain by the British Standards Institution. Fortunately for the industry there has been a large measure of international agreement on specifications, so that American and British Standards are often identical. This circumstance certainly makes for easier working.

The British Kinematograph Society recognises the great importance of standardisation in the motion picture field and a Standards Committee has recently been formed to consider standardisation work in general, and draft British Standard Specifications in particular, when these are circulated for comment prior to publication. The Library holds available for reference complete sets of current British and American Standards, while earlier Standards of American origin may be consulted in appropriate issues of the *Journal of the Society of Motion Picture Engineers*, of which we have a nearly complete set.

HEPWORTH EXHIBITION

It is not generally known that Cecil M. Hepworth was, in the later years of his life, a prolific artist in watercolours. An Exhibition of about 60 of them is to be held at Foyles Art Gallery in Charing Cross Road, W.C.2, during May. The majority are landscapes of the Buckinghamshire countryside near his home, but there are also interesting scenes which he painted while on holiday in France, Belgium and parts of Southern England. The watercolours are on sale, at prices from five guineas.

The original drawings which Mr. Hepworth made to illustrate his autobiography, *Came the Dawn*, published by Phoenix House will be shown, and copies of the book will be available. Stills from nearly all the famous Hepworth films, from the very early days of *Rescued by Rover* will be displayed. Included are pictures from well remembered films such as *Comin' Thro' the Rye*, *Alf's Button*, the very first film version of *Hamlet*, *Barnaby Rudge* and *Oliver Twist*. Early portraits of celebrated stage and film stars, viz., Ronald Colman, Stewart Rome, Leslie Henson, Mary Brough, Alma Taylor and Chrissie White, etc., will also be of interest.

The Exhibition will be opened on May 7 by Sir Gerald Kelly and remain open until the end of the month.

SITUATION VACANT

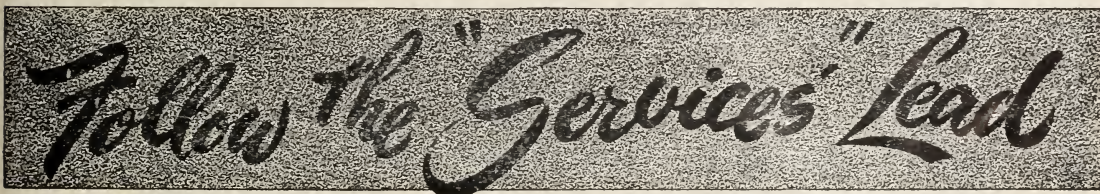
Her Majesty's Colonial Service

A vacancy exists for a Film Director (Malayan Film Unit) Department of Information, Federation of Malaya (CDE 148/60/09). Candidates must have wide experience in the making of documentary films as a cameraman and director. Knowledge of dubbing processes an advantage. Duties will be to direct the making of documentary films.

Appointment is non-pensionable and on agreement for three years in the first instance. Salary according to qualifications and experience, in the scale £840 - 42 - £1,340 plus expatriation allowance of between £265 - £310 according to salary. A cost of living allowance is also payable. Income tax at low local rates.

Quarters provided, when available, at moderate rent. Free first class passages for officer and wife and children under age of 10. On first appointment passages limited to four persons excluding officer. Vacation leave in United Kingdom at rate of 45 days for each year of resident service granted after three years satisfactory service.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number (CDE. 148/60/09).



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BRITISH KINEMATOGRAPHY

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THE NEWLY ELECTED HON. FELLOWS



Mr. G. W. Pearson, Dr. Leslie Knopp and M. André Debie at the Informal Luncheon of the Society, held on the occasion of the Third Convention, on Saturday, May 9, 1953.

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MODERN TENDENCIES IN 16mm. PROJECTOR DESIGN

C. B. Watkinson (Member)*

Read to a meeting of the 16mm. Film Division on January 14, 1953

PERHAPS "some modern tendencies" would be a better title for this paper, for as a survey it is far from complete. Overseas projectors have been intentionally omitted, and developments that took place before the beginning of 1952 are excluded; there are also several deliberate omissions which imply not that such machines are unworthy of notice, but simply that the author has little practical experience of them.

But even after making these qualifications one approaches this theme with misgivings. An account of "modern tendencies" in projectors can easily degenerate into nothing more than a catalogue of what one hopes are interesting features, unless behind the tendencies one can discern a trend—some unifying factor that will serve as a peg on which to hang each individual fact.

Efficiency

At first sight, however, the trend in 16mm. projectors since the war has been towards increasing diversity—almost a contradiction in terms. But there is indeed a discernible trend—and a significant one. It can be described in one word: "efficiency." If we agree to define efficiency as the ratio between effort employed and useful work done, current tendencies in projector design can be viewed as part of a coherent scheme.

The "modern tendency" with which we are concerned is then the increasing efficiency of 16mm. projectors. Of course, the assertion that projectors are becoming more efficient does not necessarily mean that each successive model from each manufacturer puts more lumens on the screen or more watts of sound into the auditorium. That is often the case. Efficiency, however, has yet another meaning. A new mechanism is more efficient than its predecessor if it does more work for the same cost, whether in money or in energy. It is

also more efficient if it does the same work for less cost.

The current Debie D16 is an example of the first type of improvement, where modifications of design lead to greater useful output for what is more or less the same productive effort (our energy input) by the manufacturer. This machine has undergone a number of detailed changes in the last few years—

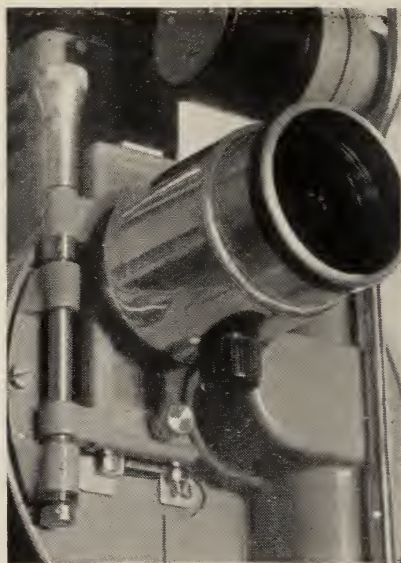


Fig. 1. The larger lens barrel fitted to the Debie D.16.

a deliberate curvature applied across the film in the gate, as a means of improving picture definition at the edges of the screen, is one of the more interesting of these—but the most striking improvement appeared less than a year ago.

Until then, the standard 2-in. lens on this projector had an aperture of $f/1.5$. In conjunction with a condenser of 0.6-in. diameter and the usual 750-watt lamp, it gave a light output that was by no means unsatisfactory.

* Current Affairs, Ltd.

Then in one stride, the manufacturers increased the light output of the Debie by a factor ranging from 61.5 per cent (derived in a series of tests the author witnessed) to 70 per cent (in further tests made under perhaps more favourable conditions). Clearly such an improvement is worth having, yet it was brought about by minor structural changes—principally the fitting of a larger lens barrel—and with no delay to production. The additional light came from a new French objective with an aperture of $f/1.2$, against the earlier $f/1.5$, in conjunction with a larger condenser, increased in diameter from 0.6-in. to 0.85-in.

During this section of the paper the Debie D.16 was demonstrated with the original lens and condenser and then with the modified components. Finally, the modified machine was operated with a standard sound-on-film release print.

For the next illustration of this “more work for less effort” trend, we have the British Thomson-Houston Company’s new sound machine, Model 401. The 401 is scarcely a modification of an existing type ; so many changes have been made that it is best regarded as a new model with a strong family resemblance to its immediate predecessor, Model 301.

One major difference is that the 301 is “blimped,” while the new 401 is not. Dispensing with the sound-absorbing case (and removing the mains transformer) has brought about a very useful reduction in weight—from 53 lb. to 38 lb.—and an even more spectacular reduction in volume ; Model 401 occupies 1,340 cubic inches, considerably less than the earlier machine.

But it is not the function of a blimp to keep dust off the film ; it is there to keep mechanical noise from the audience. So the absence of the blimp in Model 401 must, as it were, be an external manifestation of important noise-reducing modifications within.

One is the “anti-click” cam. In the new intermittent mechanism—a beautiful piece of engineering—the heart-shaped cam has been reshaped and is now asymmetrical. The

effect of this asymmetry is that, on first entering the sprocket holes in the film, the claws move down slowly until their lower edges are virtually in contact with the film. Acceleration then proceeds in the normal way, but the slow initial movement halves the impact-velocity between claws and film and so reduces click.

While the cam reduces noise even in a new machine, another cause of quieter running should show itself only after extensive use. The twin claws in this model are made of tungsten carbide and their working edges should therefore retain a smooth profile throughout the life of the machine. After

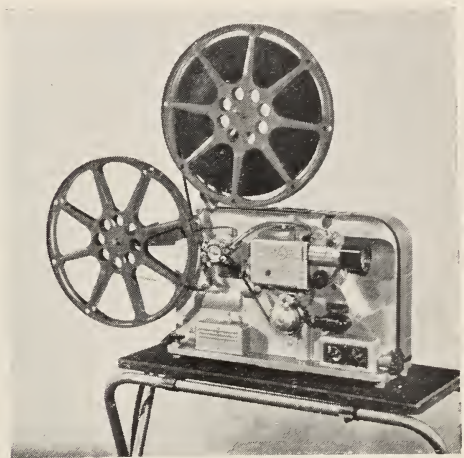


Fig. 2. The B.T.H. Model 401 projector.

countless high-velocity impacts on stationary film, claws made of the more usual materials become undercut ; unless replaced or filed down their action on entering, and particularly on leaving, the sprocket holes is that of a saw. These extremely durable peckers should help not only to reduce noise but to prevent damage to the perforations on the film, even after the projector has had long use.

While unwanted noise is kept low on the 401, there should be no lack of the more desirable kinds of sound. The amplifier here has a rated output of 30 watts and gives improved sound quality over a wide range.

To incorporate an amplifier of this increased power within a projector whose overall dimensions are smaller is far from easy: a two-storey arrangement has been adopted and the five valves—two EL37s (power output) and three miniature 6AU6s—have been tidily fitted in. All the power pack components are housed in the mains transformer and rectifier unit, which feeds lamp, motor and amplifier through a multi-core cable.

Among other improvements are a simplified threading procedure, more accessible controls, and a modified sound optical unit and sound head that give a better signal-to-noise ratio and limit flutter to 0.19 per cent. It must be added that changes to the optical system have brought the light output up to 310 lumens with the shutter running. This is a high figure: the exacting American Joint Army-Navy Specification, JAN P 49, calls only for 275 lumens from a 750-watt lamp. In all, the 401 is a most promising new model.

A second example of all-round design changes which together produce a substantial increase in efficiency is provided by the Stylist Major, the latest Simplex-Ampro projector made by Kelvin and Hughes. This machine is a neat synthesis of the Amprosound Premier-20, a heavy duty projector introduced soon after the war, and the more recent light-weight, the Stylist. It has the good performance of the one and the good looks of the other: the Major also has some distinctive features of its own.

Whereas the Stylist is a light-weight model for relatively small audiences, the Major has a greater light output in consequence of a faster pull-down speed, new condensers and a new f1.6 objective, all with bloomed surfaces. The amplifier, too, is better. One 6BR7, two 12AX7s, and three 6BW6s give an

output power, at low distortion level, of $12\frac{1}{2}$ -watts—the peak power is 15-watts.

More light and more sound are the things of which the audience is immediately conscious, but from other standpoints, too, the Major is a more efficient machine than either of its predecessors. For example, it has been made easier to thread by the simple expedient of moving the sound flywheel from the operating side, where it restricted access to the sound drum, to the opposite end of the sound drum shaft. Another worth-while change is the fitting of a pair of sapphire pressure pads to the curved guide that leads

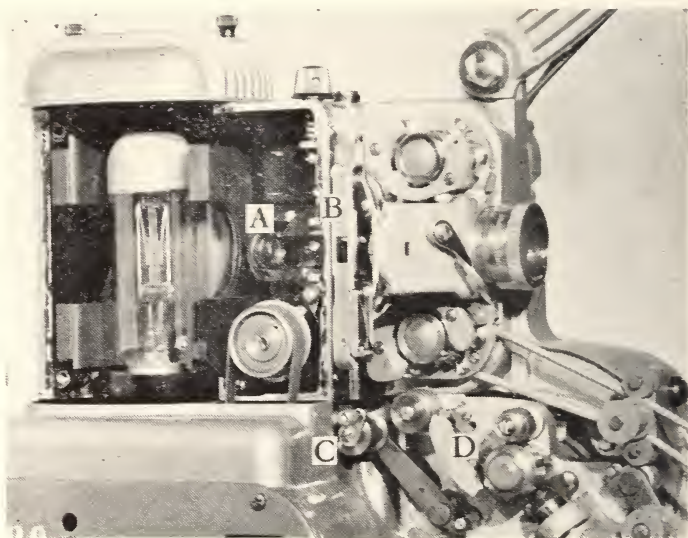


Fig. 3. The Stylist Major, showing (A) the heat filter for still-picture projection, (B) the swing-open film gate, (C) the loop re-setting roller, and (D) the jewelled film guide.

film down to the sound drum: probably this is the only British projector to use jewels, applied in such abundance to the luxurious American machines like the new De Vry "Pro." The sound optic has been modified, and the film gate can now be swung open for cleaning without interfering with focus.

Internally, most of the earlier Ampro features have been retained, but an important

exception is the gearing. Previously, self-lubricating Tufnol gears were used for all except the low-speed components. These have now been replaced with nylon gears, which appear to be practically everlasting.

The Stylist Major was demonstrated with a standard sound-on-film release print.

The projectors so far discussed are typical of those which attain higher efficiency by using the same means to better effect. To the second category belong machines which provide the same effect but with more economy of means, either in terms of cost, complexity or flexibility.

If this more limited aim is selected, a number of possible economies suggest themselves to the designer whose object is to increase projector efficiency.

First, there is light output. It will probably be agreed that next to bad sound the most common cause of poor presentation is a dim screen. If the projector is ever to be used for an audience of several hundred people, then 250 lumens is a minimum requirement. But if the projector will remain for the whole of its working life in an office or living room provided with an adequate black-out, a light output of such magnitude, far from being necessary, may even prove a liability by degrading the shadow areas of the picture.

Precisely the same argument can be applied to sound, though a power-handling capacity of at least 10 watts is perhaps desirable to cope with the peaks.

Similarly with many other refinements : still-picture devices and reverse mechanisms, even a 16 frames/sec. governor, are perhaps valuable for the teacher at school ; they are quite useless—and may seem just sources of needless expense and possible breakdown—to a professional exhibitor who projects sound films to theatrical audiences.

We find then, that 16mm. projectors possess two sorts of qualities. There are on the one hand those characteristics which every machine *must* possess, wherever and however it is to be used : these include tolerable picture steadiness ; dynamic resolution (not always present to-day) that enables the cast list of a

typical feature to be read at, say, six screen-widths from the screen ; a degree of sound stabilization that will prevent flutter and wow from seeming unpleasant, except to the critical musically-trained ear ; and above all an ample reserve of "top." This latter requirement can perhaps be translated as calling for an effective scanning beam width of 0.0005 in. or less.

On the other hand there are those characteristics which are desirable, and may be essential, for some users but not essential for all. They include the highest possible standards of picture and sound reproduction and, among the additional facilities, the reverse mechanisms, still-picture clutches, and so forth.

In short, there is a market for a variety of projectors with as wide a range, operationally, as the radio industry offers to users of broadcast receivers. A projector can therefore be considered efficient not only to the extent that it is all things to all men (these projectors will always be required) but also to the extent that it gives a specific user what he needs—and nothing more.

Several manufacturers have already set their feet on this road to higher efficiency. One of them is the British Thomson-Houston Co. Ltd. : Model 301 was used as the basis both of a smaller machine for schools and a larger one for big auditoria. A small family of projectors has also been derived from the Debie (whose basic silent machine has been known, after a series of moults and additions, to finish up with a very large amplifier and a carbon arc), and to a lesser extent from the Ampro. The Ampro Stylist can be bought silent, with an amplifier compartment but no amplifier, and with a body casting that lends itself to the attachment of a sound system at any time the purchaser decides to make the change.

But from the user's point of view it makes little difference whether the simple and the elaborate projectors come from the same stable : they may just as well be produced in different factories. At present there is only one company specializing in these "utility" machines (the word is not used in a derogatory

sense) which lack all but the essentials. Their product is the Danson 540. This machine—a substantially-modified version of the Italian Safar—has a 500-watt lamp and a single internal transformer for lamp, motor and amplifier. There is no reverse mechanism, no still-picture device and, apart from an adjustable governor, the minimum of trimmings. But it retails at less than £150 and when regard is paid to its intentional limitations it gives a fully satisfactory performance.

A short sound-on-film demonstration was given at this stage by the Danson 540 projector.

Leaving specific makes of machine, the author would like to express a few wholly personal views about 16mm. projectors in general.

There is probably no projector in current production which, if properly threaded, will cause damage to the perforations, provided the perforations were intact beforehand. But—at least in the author's experience—neither do there seem to be many projectors that cannot, under certain conditions, cause film scratch.

Ignoring sticking rollers (for these are due to incompetent maintenance) the major source of scratch seems to be the film gate. Here, two kinds of damage can occur. One is the marking of the picture area, front and back, because there is so little clearance between the film and pressure plates that even small particles of grit or emulsion can lodge there with disastrous results. Even if the result is a less sharply-focused image of the mask on the screen, greater clearances would, I believe, be well worth providing.

But gates are responsible for another kind of scratching that is unfortunately so general that many libraries regard it as an inevitable consequence of the first booking. It is that familiar white line on the emulsion side (it will shortly become a system of lines), running between track and picture from one end of the film to another.

The cause is plain enough ; it is the inner of the three (or four) skids on the front pressure plate. But is there a cure ? It has been said that none is needed, because this kind of

mark occurs on a neutral part of the film. In theory it does ; in practice the sideways positioning of film in the gate is rarely so precise that this can be relied on. Sooner or later, one of these skid marks will arrive on the sound-track, where it will reduce the overall signal-to-noise ratio, or on the picture, where it will spoil everyone's enjoyment of the film. Waxing helps to prevent the emulsion from being scraped off, but does not afford complete protection.

Since the scratch between picture and sound-track is caused by the inner skid on the front pressure plate, the remedy that immediately suggests itself is the removal of the offending skid and of course of the complementary skid (if one is fitted) on the aperture plate on the lamp side of the film. This is unorthodox, perhaps even heretical, but it is far from impracticable.

Such a modification was in fact carried out more than a year ago on a projector that is in constant use for viewing new (and generally green) prints and has proved most satisfactory. On this machine, the skids originally made contact with the film at the edge outside the perforations, at the junction between track and picture, and at the outer edge of the sound-track. After modification, skids still touch the film at three points, but the intermediate skid has been moved from the track/picture junction to the narrow neutral area between the inner side of the sprocket holes and the edge of the picture. In these positions, none of the skids can mark either track or picture ; even if mechanical damage to the runners causes film scratch, its effects will be both invisible and inaudible.

The price paid for longer print life, better sound and cleaner pictures is a small one. The picture itself is no longer symmetrically supported and in consequence the position of optimum focus on the screen is shifted slightly to the right of centre. Careful tests have however shown that there is no increase in picture float, either vertically or horizontally. This in part is due to the fact that both plates are machined from stainless steel and after hundreds of hours of use have thus retained their original smoothness ; chrom-

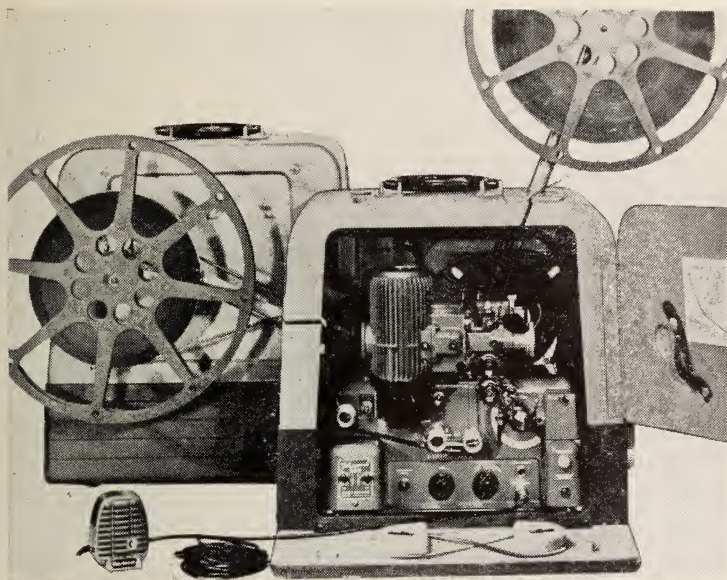


Fig. 4. The Bell & Howell 202, which gives the choice of either magnetic or photographic reproduction at the turn of a switch.

ium-plated gate assemblies, however smooth initially, seem inevitably to develop soft spots that pick up emulsion after a few thousand feet of dusty film have passed through them.

Space does not allow more than a brief reference to a few minor weaknesses that still seem to be unnecessarily prevalent. Framing controls, in general, do not provide sufficient latitude for correctly racking some of the older films, and volume control potentiometers too quickly develop noisy tracks. More robust controls are needed; those who design the amplifiers seem to overlook the fact that, on a 16mm. projector, gain has to be adjusted far more often than on a radio. Lastly—will there ever be a threading light that shows us whether the gate is clean?

Lest these final remarks have given the impression that the author is less enthusiastic about 16mm. projectors than befits a member of this Division, he must add in conclusion that after projecting more than 3,000 films on them, his admiration continues to grow for their precision and astonishing reliability (we often forget, perhaps, that parts of the projector start, stop and reverse 72 times every second).

Raymond Spottiswoode expresses this much better in *Film and its Techniques*. He

says: "16mm. film is not an inferior substitute for 35mm. Rather, the development of 16mm. film corresponds to that period in horological history in the early 19th Century when watchmakers, not without some scorn from the older members of their craft, were

trying to compress the accuracy, the reliability and the longevity of the grandfather clock into a quarter of a cubic inch. The relative sales to-day of watches and grandfather clocks should give pause to those who doubt 16mm. film's potentialities."

The final demonstration was of the Bell & Howell magnetic/optical projector, Model 202. A short descriptive film was screened; later the author recorded and played-back a short passage on the half-width magnetic stripe and explained that a British version of this projector, to be known as the G.B.-Bell & Howell 630, would shortly be available.

Acknowledgments

For their help in preparing this paper and providing demonstration projectors, the author would like to thank the British Thomson-Houston Co. Ltd., Cinetechnic Ltd., the Danson Development Co. Ltd., G.B. Equipments Ltd., and Simplex-Ampro Ltd. He would also like to express his gratitude to Mr. Lyndon C. Vivrette, film officer of the United States Information Service, for his kindness in supplying the demonstration films, and to Mr. Bernard Dolman ("Film User") for his encouragement and for providing facilities without which the paper could not have been written.

EASTMAN COLOUR FILMS FOR PROFESSIONAL MOTION PICTURE WORK

G. J. Craig, O.B.E. (Fellow)*

Read to a meeting of the Film Production Division on April 15, 1953.

IN modern processes of colour photography a technique has been established by which colours are analyzed in accordance with their reflectances within the three broad spectral regions, blue, green and red. This can be done, either by taking three separate photographs through blue, green and red filters on normal panchromatic emulsions, or by using emulsions with colour sensitivities localized as far as possible to the appropriate spectral bands.

The photographs may be recorded on three separate films, as in the Technicolor camera, or on a single normal picture negative film, as in the successive frame method used for animation work. Yet another system is one in which a multilayer film is employed, with the emulsions coated one above the other on a single support. If the three layers can be separated after exposure then black and white images may be used—Multilayer Stripping Film¹ is an example of this technique. But if the multilayer is integral, and not meant to be separated, the images must be selectively coloured to allow for subsequent separation by colour analysis.

When the three separation records have been made, there are two basic methods whereby the scene can be reproduced in colour: additive and subtractive synthesis. The additive method is outside the scope of this paper.

The subtractive method makes use of certain dyes and pigments which have the property of selectively absorbing blue, green or red light while transmitting the remainder of the spectrum. These dyes and pigments are called the subtractive primaries, and they control the amounts of blue, green and red light in a mixture by absorbing or

subtracting from white light the amounts of blue, green and red not required.

For this purpose, three positive images in dye or pigment form are prepared from the separation negatives, the red separation negative being printed in the red-absorbing or Cyan dye; the green negative in the green-absorbing Magenta dye; and the blue negative in the blue-absorbing Yellow dye. The three images may then be superimposed on a single support to make the completed colour reproduction.

The Eastman Colour Films are multilayer films of the type in which the layers are not separated after exposure. Films of this class are known as Multilayer, Monopack or Integral Tripack. "Multilayer" is descriptive not only of this particular group of films, but also those in which the layers may be separated after exposure, while "Monopack" is liable to be associated with a particular process which has been quite widely employed by Technicolor. "Integral Tripack" is therefore adopted as the most convenient term for describing the Eastman Colour Films.

Three types of Eastman Colour Film are manufactured. These are the Colour Negative Film, intended for use as the picture negative material in the camera; the Colour Internegative Film, used for a similar purpose to black-and-white duplicating negative film; and Colour Print Film, which may be employed in preparing prints from either the Colour Negative or Colour Internegative. A special black-and-white Separation Positive Film is also provided and this is intended for use in preparing three separation positives from the Colour Negative. The separation positives form an intermediate link with the

* Kodak, Ltd.

Colour Negative when making a Colour Internegative, so that their function is similar to that of a master positive in a black-and-white system.

Integral tripack camera films have the advantage that they may be used in a standard black-and-white camera, and apart from a check on the colour correction and focus of the lens, no special precautions are necessary. It is of interest to note that the colours of integral tripack negatives, as well as the densities, are reversed compared with the original scene.

The coloured images in Eastman Colour Films are produced by a method known as dye-coupling development. For this a special developing agent is used in conjunction with a second compound known as the colour-forming coupler. Photographic development is a process of chemical reduction brought about by the developing agent, which is oxidized in proportion to the amount of silver formed. The oxidized developing agent combines with the colour forming coupler to create a dye of appropriate colour, the concentration of which is proportional to the amount of silver in the image. The dye thus formed must be insoluble in water so that the reaction shall be quite local and a dye image of high resolution obtained. The silver image is removed at a later stage of the process.

Three colour-forming couplers provide the appropriate dyes and are incorporated in the relevant emulsion layers.

Colour Rendering and Image Sharpness in Integral Tripack Processes

At present, there are two basic problems associated with the design of a satisfactory integral tripack process. The first of these is accuracy of colour rendering which, of course, is not confined to the integral tripack system but is of special importance in this case because of the practical problems involved in correcting deficiencies. The second factor is image sharpness, necessarily important because the optical image loses sharpness by light scatter when it passes through successive emulsion layers. Special measures have

been adopted to meet these problems in the design of Eastman Colour Films.

Certain theoretical difficulties in the accuracy of colour rendering by additive and subtractive processes have already been described before this Society.² Another practical problem is concerned with the transmission characteristics of the dyes formed in colour development. Ideally, the dyes used in a subtractive process should completely absorb one-third of the visible spectrum and completely transmit two-thirds. In practice, the available dyes fall considerably below this aim. Conse-

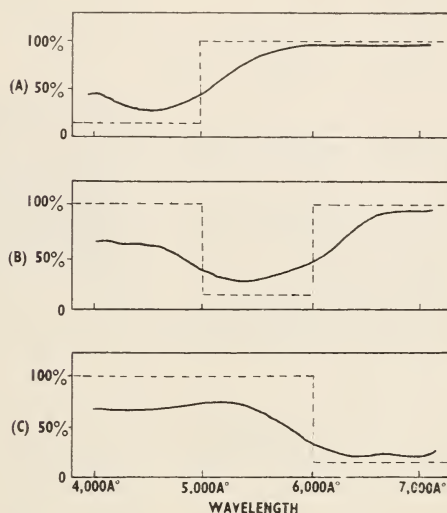


Fig. 1. Spectral transmission curves for theoretical and practical subtractive dyes. The ideal theoretical characteristic is represented by the dotted line.

A Yellow
B Magenta
C Cyan

quently there is appreciable colour degradation, even when only one set of dyes is involved as in a reversal process, if the original camera film is subsequently used as the projection positive. Degradation is considerably greater when a negative has to be printed on a positive material having dyes with similar characteristics, and worse still after passing through a duplicating stage. Transmission characteristics of ideal and practical subtractive dyes are shown in Fig. 1.

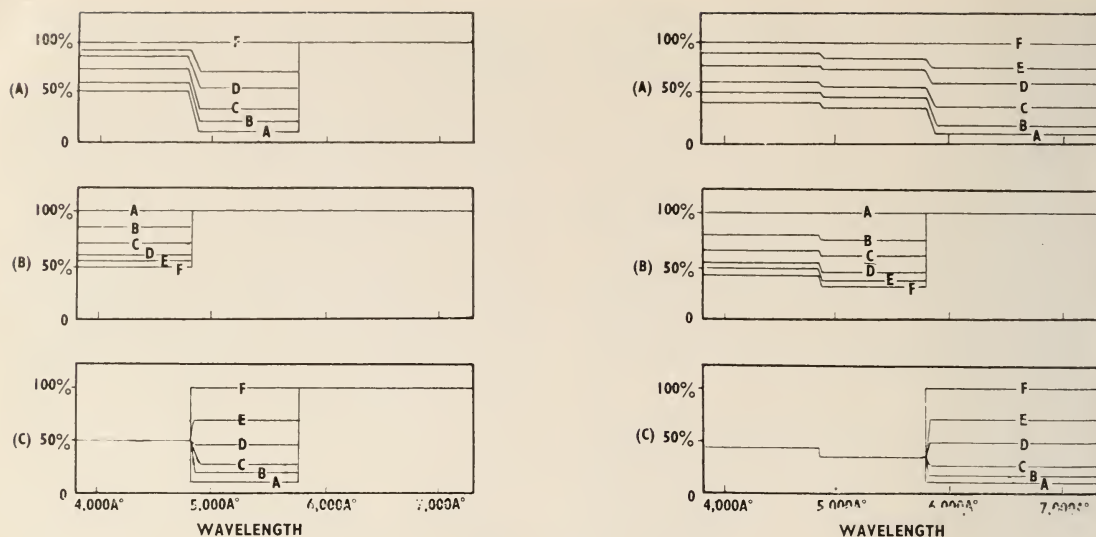


Fig. 2. Action of coloured couplers.

Diagrammatic representation of the behaviour of a compensating coloured coupler for the magenta dye image.

- Transmission curves (F-A) for the magenta dye at various concentrations, showing unwanted absorptions in the blue.
- Transmission curves (A-F) for the compensating coloured coupler image.
- Curves from (a) and (b) combined to show the final transmission characteristic, with the unwanted absorptions equalized at 50 per cent.

Diagrammatic representation of the behaviour of a compensating coloured coupler for the cyan dye image.

- Transmission curve (F-A) for the cyan dye at various concentrations, showing unwanted absorptions in the blue and green.
- Transmission curves (A-F) for the compensating coloured coupler image.
- Curves from (a) and (b) combined to show the final transmission characteristic with the unwanted absorptions in the blue and green equalized at two different levels.

Automatic Masking by Coloured Dye Couplers

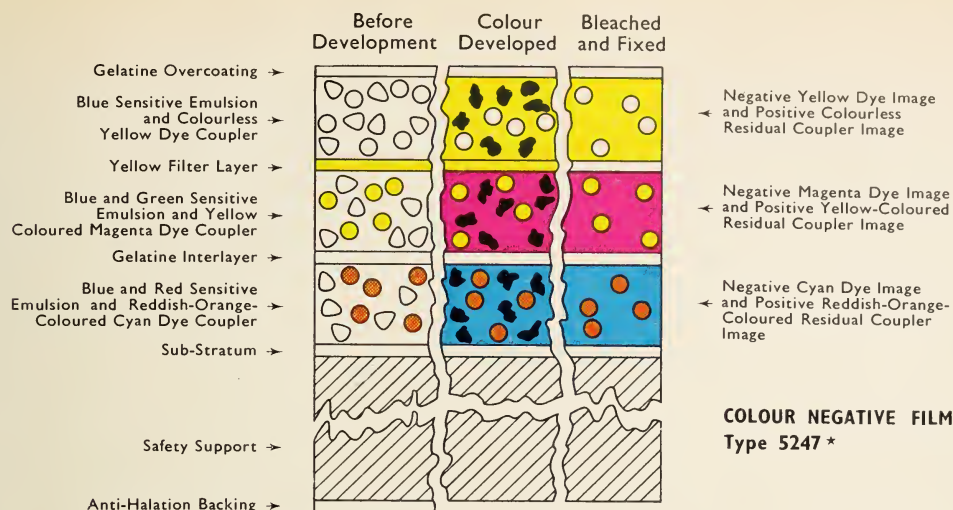
In Eastman Colour Films the transmission characteristics of the yellow dye are fairly good, but the magenta dye absorbs rather heavily in the blue where there should be full transmission, the degree of absorption varying with the dye strength. Similarly the cyan dye absorbs in the blue and green, where it should fully transmit. These shortcomings, if uncorrected, would have considerable adverse effect on the colour quality, and the reproduction would be desaturated and false in colour rendering.

This situation is a familiar one in subtractive colour processes, and some correction is often attempted by a technique known as masking, in which one or more compensating weak positive images are combined with the negative during printing. Such masks are used with the intention of cancelling out the unwanted blue and green absorptions in the cyan and magenta dyes of the negative image.

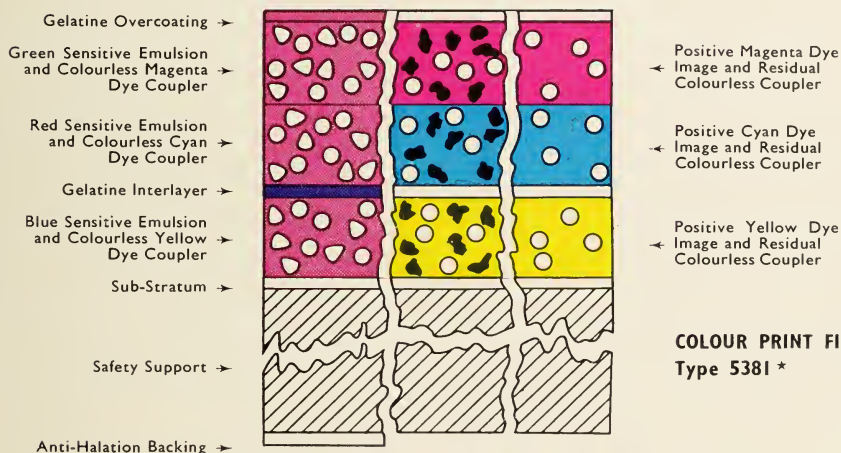
Eastman Colour Negative and Internegative Films incorporate a very valuable masking device, the coloured dye-coupler, which provides the necessary correction automatically.

It will be appreciated that if the magenta dye is absorbing some blue, and the cyan dye some blue and green, then the final print will appear desaturated and wrongly coloured. If, however, the unwanted blue and green absorptions can be made constant, no matter what the dye image density, it will be easy to rectify the deficiency during printing, simply by placing a suitable colour compensating filter in the printing light beam, or alternatively by adjusting the overall colour balance of the tripack print film.

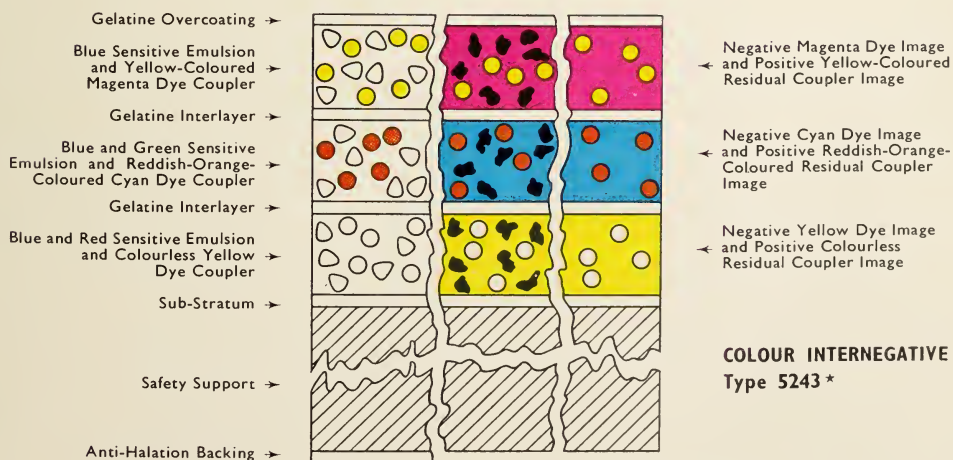
The coloured dye-couplers used for the formation of the magenta and cyan dyes in the appropriate layers achieve this in the following manner. The magenta dye-coupler is coloured yellow and absorbs in the blue



COLOUR NEGATIVE FILM
Type 5247 *



COLOUR PRINT FILM
Type 5381 *



COLOUR INTERNEGATIVE FILM
Type 5243 *

* Types 5248, 5382 and 5245 are, respectively, similar



region of the spectrum where unwanted absorption is taking place. The coupler is used up as the dye image is formed, so that where image density increases, the colour strength of the coupler decreases. Thus where there is high image density, and therefore high unwanted blue absorption, there is low coupler concentration with consequent low blue absorption. The coloured coupler can be selected so that its maximum absorption corresponds to the blue absorption of the magenta dye at maximum density. In such a case the combined blue absorption of the magenta dye and residual coloured coupler is constant, and remains substantially so at all intermediate densities. A similar function is performed by the coloured coupler in the cyan layer, which is reddish-orange in colour. The behaviour of these coloured couplers is represented diagrammatically in Fig. 2.

The colours of these two couplers result in an orange hue which is visible in the processed negative and obscures the actual colours in the negative to an extent which makes visual assessment impossible. This system of masking is adopted only in the negative stages of the colour process: it cannot be embodied in the final print because of the orange hue of the couplers.

Image Sharpness

When considering maximum sharpness in a subtractive type colour process it must be remembered that the magenta image has the greatest influence upon the sharpness of a projected picture, the cyan image is next in importance and the yellow image least. It is therefore desirable in an integral tripack film, because of the light scatter in the layers during exposure, to arrange for the magenta image to appear in the top layer, the cyan image in the middle and the yellow image at the bottom.

With the camera negative film such an ideal arrangement is not possible, for in practice the blue sensitive layer (forming the yellow image) has to be placed at the top. A high speed picture negative emulsion is strongly responsive to blue light, so that although two of the three layers in the film

can be selectively sensitized to green and red, the fundamental blue sensitivity of the silver halide emulsion is always present and must be eliminated from the green and red sensitive layers by the use of a yellow filter.

It is for this reason that the blue sensitive layer must be placed at the top; in such a position it is a simple matter to locate beneath it a yellow filter layer which will completely remove the blue light while transmitting green and red. The filter layer can be designed to be eliminated during processing of the film.

In the print film it is possible to achieve the desired dye layer arrangement because high emulsion speed is not essential, as in the camera negative material, and this permits selection from a wider range of emulsion types.

The internegative film presents a special problem, for although it is a low speed material, and as such might follow the same design as the print film with regard to layer positioning, the fact that coloured couplers are incorporated for automatic masking complicates matters. The blue-absorbing yellow and orange-red couplers would prevent an image being registered on the blue sensitive emulsion if it were at the bottom. The problem is solved by adopting a non-complementary relationship between the dye image colour and spectral sensitivity of each layer.

Non-Complementary Dye Relationship

In conventional integral tripack materials Yellow, Magenta and Cyan dyes are used for the formation of images originating in the Blue, Green and Red sensitive emulsions respectively. This is because each dye absorbs in the particular spectral region to which the emulsion is sensitized, while freely transmitting (at least, in theory) all other parts of the spectrum. In other words, the dyes bear a complementary relationship to the spectral sensitivities of their respective layers. They control light transmission in exactly the same way as does a silver image, but exercise of this control is confined to light of wavelengths within the colour sensitivity region of the appropriate emulsion. If,

therefore, blue, green and red are accepted as the normal regions for which the three emulsions are sensitized, then the normal complementary relationship with the dye image will be Blue/Yellow, Green/Magenta, Red/Cyan. Such a relationship is obligatory, for example, in a reversal type camera film intended for subsequent use in projection; but when integral tripack films are employed at an intermediate stage between the camera negative and final print it is by no means essential for this complementary relationship to be maintained, so long as it can be established in the print. These films may therefore have a non-complementary dye relationship.

Eastman Colour Internegative Film has a non-complementary dye relationship in that the top emulsion layer is blue sensitive and forms a magenta image, the green sensitive middle layer forms a cyan image, and the red sensitive bottom layer a yellow image. In

this way, the desired layer positions for the subtractive images are obtained.

Use of this technique in the internegative film is permissible as it is used in conjunction with black-and-white separation positive films. Suitable light filters can be employed when printing from the separation positives on to the internegative to match the non-complementary dye relationship of the latter. (See Fig. 3).

Preparation of an Internegative

To make an internegative, three separation positives are first prepared. These represent separate records of the three dye images in the original negative. They are obtained by printing the negative successively on the three films using blue, green and red printing lights of suitable quality. Ignoring dye deficiencies, the blue light is obstructed only by the yellow layer in the negative and freely

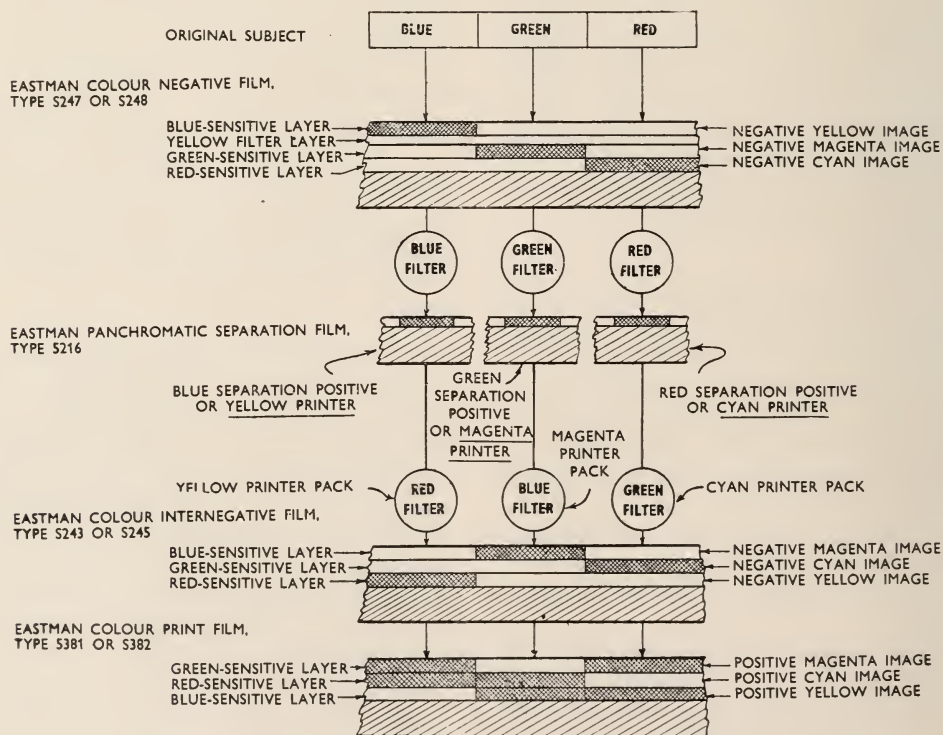


Fig. 3. Diagram showing the general arrangements for making a final print via an internegative. Note that to allow for the non-complementary dye relationship in the internegative film, printing from the blue record separation positive is by red light, the green record by blue light, and the red record by green light. With the usual complementary dye relationship blue, green and red light would have been used.

transmitted by the magenta and cyan layers: in the same way green light is affected only by the magenta layer and red light by the cyan layer.

The blue record separation positive is called the Yellow printer, green record the Magenta printer, and red record the Cyan printer, because those are the respective dye layers they control in the internegative.

The separation positives are now successively printed on to the internegative film, suitable light filters again being used to restrict the exposure from each positive to the appropriate emulsion layer of the film. It will be apparent, therefore, that red light must be used with the Yellow printer, green light with the Cyan printer and blue light with the Magenta printer. Production of an internegative in this way is shown schematically in Fig. 3.4

General Properties of Eastman Colour Films

(a) *Eastman Colour Negative Film.*

Eastman Colour Negative Film is at present manufactured in two types, identified as 5247 and 5248. Type 5247 is suitable for use in daylight illumination, or in high intensity arc light with a straw-coloured filter, such as the Brigham Y.1, before the lamp. In either case a Wratten No. 2B filter should be used on the camera lens to absorb ultra violet radiation. The Exposure Index* for Type 5247 is 16.

Type 5248 is colour balanced for use in tungsten lamp illumination at a colour temperature of 3200°K. In practice, CP lamps operating at 3350°K can also be used, since correction for small differences in colour temperature of the light source can easily be applied during printing. It is not advisable, however, to attempt the lighting of subjects with lamps of mixed colour temperature, at least until ample experience has been gained.

Type 5248 has an Exposure Index of 32 to tungsten illumination. As a guide to lighting level, a key light of 200 foot candles at $f/2$ is recommended, although lower illum-

ination values can be used if necessary without seriously affecting the quality of the negative. Practical camera tests are always advisable as a check on correct exposure.

The film may be exposed in daylight, or high intensity arc plus a straw-coloured filter such as the Brigham Y.1. In either case a Wratten No. 85 filter is required on the camera lens. In these conditions the Exposure Index becomes 24.

When working with the Colour Negative lighting contrast should be fairly soft, with evenly distributed illumination. Good modelling can be obtained with lighting ratios lower than those used for black and white work.

Although both Type 5247 and Type 5248 are manufactured at present, it is probable that in the near future production will be concentrated on 5248, especially since the two types cannot readily be intercut for printing purposes.

A diagrammatic representation of the emulsion layers in Eastman Colour Negative Film, before and after processing, is shown in Plate 1.

(b) *Eastman Colour Print Film.*

The type identification number for Eastman Colour Print Film is 5381, while an improved Type 5382, giving increased sharpness, is now being manufactured.

The film is colour balanced for exposure to tungsten lamp illumination. It is appreciably slower than Eastman black-and-white Fine Grain Release Positive Film Type 5302. As a guide to speed, an average density Eastman Colour Negative will print at light 10 on a Bell Howell Model D printer fitted with a 300-watt Reflector Lamphouse and the necessary colour balancing filters in the light beam. A Wratten No. 2B filter must always be used when printing on to the Colour Print Film in order to absorb the ultra violet radiation from the light source, which would otherwise desaturate the colours in the print.

Any standard printer suitable for black-and-white work can be used in making Eastman Colour Prints, provided it has a tungsten lamp light source and means are available for inserting colour balancing filters in the light beam to correct for differences in colour

* This Exposure Index is suitable for use with Weston, General Electric and similar exposure meters with or without the calculators for ASA Exposure Indexes. It may be regarded as an equivalent to the British Standard Exposure Index (arithmetical).

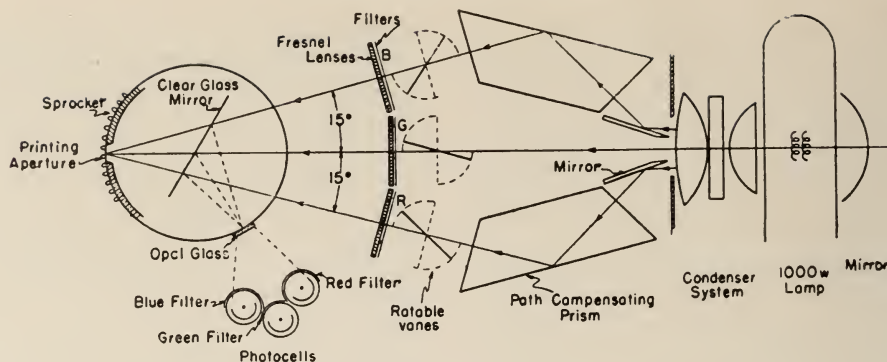


Fig. 4. Diagrammatic representation of projection-type optical system for controlled additive trichromatic illumination using a single lamp.⁵ The illumination at the printing aperture can be independently varied for each of the three light beams. Control is effected by rotating vanes working through a servomechanism which responds to signals from three filtered photocells. The photocells react to changes in brightness of the respective light beams.

balance of the negative or print film. Such a printer does not permit of the rapid filter changes often required for scene-to-scene colour balance shifts, and for this work special equipment is necessary.

A preferred type of printer is one in which the illumination at the printing aperture is obtained by mixing light from the source after it has passed in three separate beams through narrow band red, green and blue filters, the intensity of each beam being separately controlled.⁵ A diagram of the optical arrangements for such a printer appears at Fig. 4. Not only does a printer of this type provide a wider range of colour balance changes, but problems associated with the use of colour balancing filters, such as fading and complications due to unwanted absorptions in the filters themselves, are avoided. Moreover, frequent replacement of filter material is liable to become an appreciable cost item. Apart from these advantages tests have shown that improved quality is obtainable on Eastman Colour Print Film exposed in this way.

The sound track on Eastman Colour Print Film is composed of both the silver and dye images, from which very satisfactory sound quality is obtainable.³ A point of interest is that the film is perforated with American Standard Combination Negative-Positive perforations.

A diagrammatic representation of the emulsion layers in Eastman Colour Print Film

before and after processing is shown in Plate 1.

(c) Eastman Colour Internegative Film

Eastman Colour Internegative Film, designed for use in conjunction with Eastman Colour Negative Type 5247, is identified by the number 5243. A second internegative material, similar in characteristics to 5243 but designed for use with Eastman Colour Negative Type 5248, is known as Type 5245.

As has been explained, Colour Internegative has a non-complementary dye relationship and a spectrogram illustrating this is shown at Plate 1. A diagrammatic representation of the emulsion layers before and after processing is also seen in Plate 1.

Colour Internegative Film requires a printer with a high intensity light source in order to obtain adequate exposure. This is partly because the light filters employed for printing the separation positives on to the internegative have narrow transmission bands to restrict exposure to the correct emulsion layer in the film. Additional reasons are the low inherent speed of the internegative film and the necessarily high minimum density of the separation positives. As a guide to the type of printer required, adequate exposure has been obtained from separation positives of 0.8 minimum density in an equipment fitted with a 1000-watt tungsten lamp, reflector, and condenser system, and running at 25 feet per minute. A registering type printer is essential for printing from separation positives.

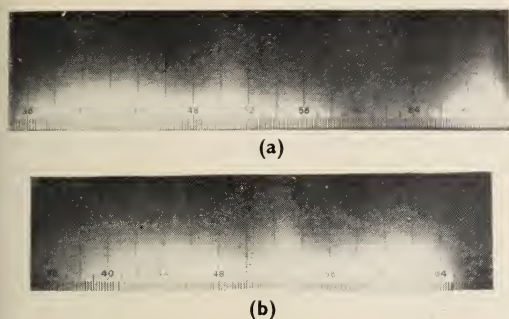


Fig. 5. Spectrograms of (a) Eastman Panchromatic Separation Positive Film, Type 5216 and (b) Eastman Fine Grain Duplicating Negative Film, Type 5203, illustrating the extended red sensitivity of the former.

(d) Eastman Panchromatic Separation Film, Type 5216.

This material, specially designed for making black-and-white separation positives from colour negative originals, is broadly similar to the black-and-white Eastman Fine Grain Duplicating Negative Film, Type 5203. However, it is capable of a somewhat higher contrast, and the definition is superior to that obtained with 5203. The film has an extended red sensitivity to allow the use of a Wratten No. 70 filter for exposure of the red separation positive. An absorbing dye is incorporated in the emulsion to improve definition, and this is not completely discharged during processing. Consequently, separation positives prepared on this material have a characteristic greenish tint.

Comparative spectrograms for Type 5216

and Type 5203 film are shown in Fig. 5, and typical sensitometric curves for Type 5216 appear in Fig. 6.

Processing of Eastman Colour Films.

Apart from an extra stage to permit removal of the silver image, the processing of Eastman Colour Negative, Colour Print and Colour Internegative Films does not differ fundamentally from the techniques applied to black-and-white materials. But control of solution temperatures and bath compositions has to be much more precise, and the processing machine needs to be built to more rigorous specifications than would be warranted for handling black-and-white films. Discretion is necessary in choice of the materials for machine construction, and efficient squeegee systems are needed at several points, especially when processing Colour Print Film, just before the sound track re-development stage. Washing is essential several times during the process, and to minimize reticulation problems it is necessary for the water temperature to be maintained within two or three degrees of the other solutions. Fig. 7 shows in diagrammatic form the various processing stages.

All Eastman Colour Films have a soluble, opaque black backing applied for the purpose of reducing halation, and this must be removed before development. It is first softened in a special bath, and from this the film passes to a rinse tank where the backing

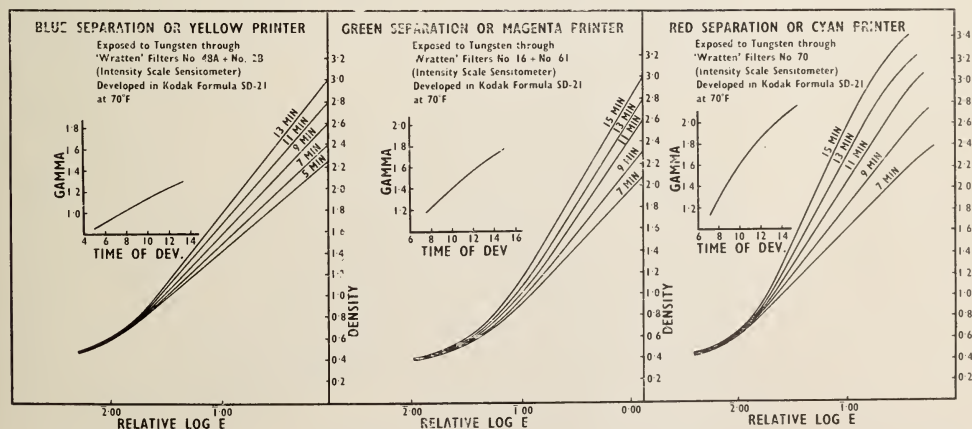


Fig. 6. Sensitometric characteristics of Eastman Panchromatic Separation Film, Type 5216, when exposed to blue, green and red light. Kodak Formula SD-21 is equivalent to seasoned D.76 developing solution.

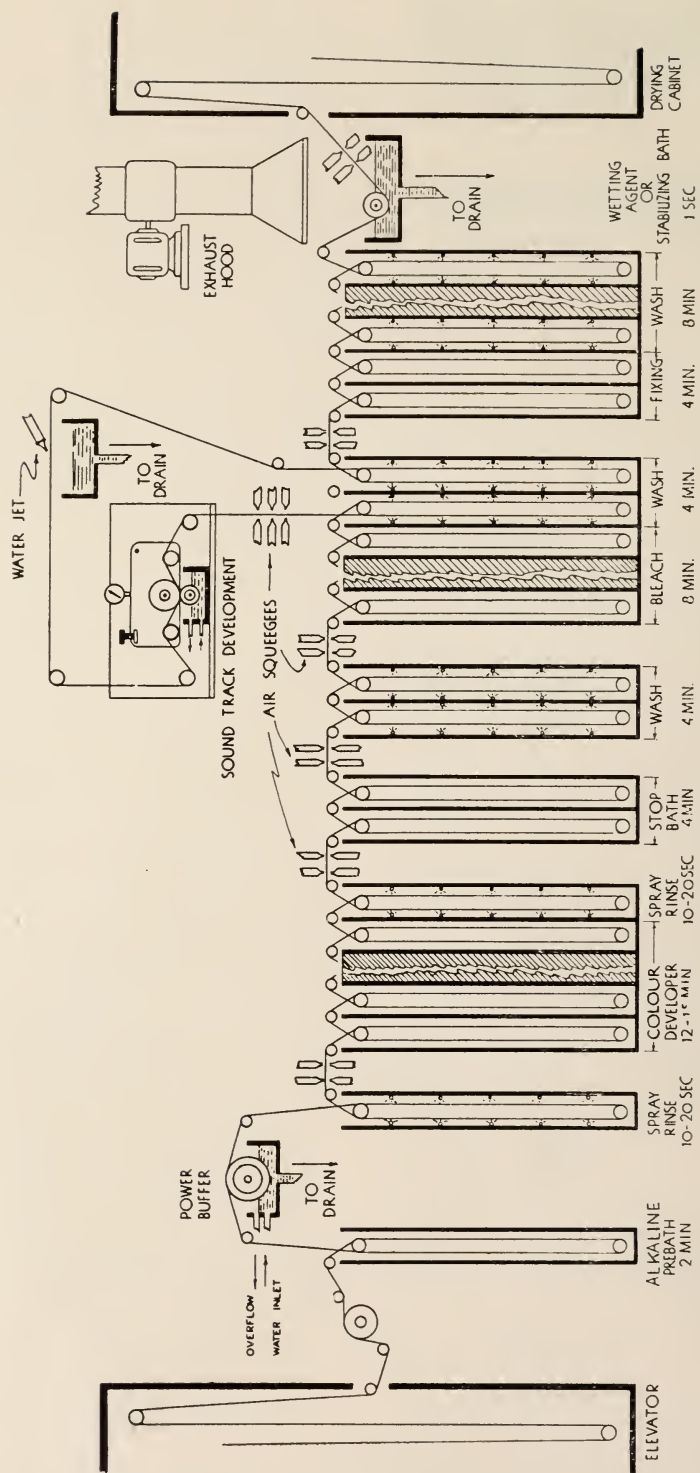
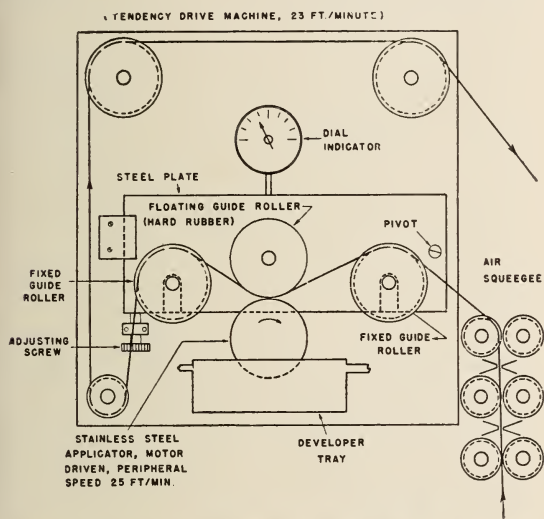


Fig. 7. Diagrammatic representation of processing machine for Eastman Colour Films.

is completely removed by buffing the support side of the film, using a roller covered with a soft material such as sponge rubber rotating in the opposite direction to the film travel.

After removal of the backing the film enters the developing solution. It is not greatly different from a black-and-white picture



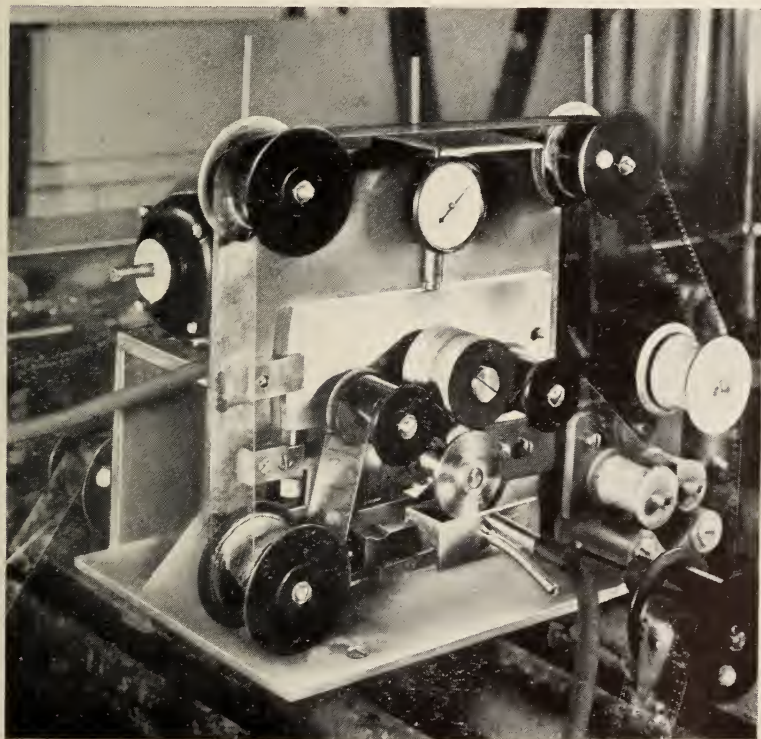
negative developing solution, apart from the special developing agent used, a very low sulphite content, and a higher pH. Development takes 12 to 15 minutes at 70°F., a combined silver and dye image being formed. In black-and-white processing the time can be varied considerably in order to control the ultimate contrast of the negative. Such methods are inadvisable when processing colour film because three emulsions are being developed simultaneously, and they may not all react similarly to a given change in development time. This can lead to an alteration in colour balance.

Development is followed by a brief spray rinse, and the film then passes into the first fixing bath, which is of the normal type used in black-and-white processing. Here the undeveloped silver halide is removed and the emulsion is hardened. A wash follows, after

Fig. 8. Diagram and photograph of an applicator for sound track re-development on Eastman Colour Print Film.

which the film enters the bleach bath where the silver image is converted to silver bromide. After a further wash the film passes to the second fixing bath, identical in composition with the first. Here the silver bromide into which the silver image was converted by the bleach bath is removed, leaving the dye image.

In the case of Colour Print Film, if a sound track has been printed there is a further step which occurs prior to the second fixing bath. A sound track composed of dye image alone is not so satisfactory as one which incorporates the silver image. It is therefore desirable to redevelop the silver bromide in the sound track area only, and this is done by applying a high energy developing solution to the sound



track after the wash following the bleach bath. A convenient method of application is by picking up the developing solution on an applicator wheel which forms a bead of developer on the emulsion surface of the film in line with the sound track. In order to prevent spreading of the developing solution into the picture area, development time is kept to a minimum and the solution is made viscous by the inclusion of suitable ingredients. A diagram and photograph of a sound track applicator wheel are shown in Fig. 8.

Following a final wash after the second fixing bath, the film may be passed directly into the drying cabinets if it is Colour Negative or Internegative, or alternatively it can first be run through a tank containing wetting agent to minimize the risk of water spotting. Colour Print Film must be passed through a final stabilizing bath, which, if desired, may also include wetting agent. The stabilizing agent, consisting of formaldehyde, is necessary because the processed print film contains unused colourless colour-forming couplers, which may cause fading of the dye image. These couplers are converted to an inert form by the action of the formaldehyde.

Conclusion

The increasing availability of integral tri-pack colour films brings nearer the time when

all motion picture productions for the commercial entertainment field will be in colour. While the inherent characteristics of the colour film itself must always be a primary factor in determining ultimate quality, it cannot be emphasized too strongly that, far more than in black-and-white photography, good results depend on a high standard of technique in the camera work and film processing. Cameramen accustomed to working with black-and-white films will find adjustments in method essential if good colour quality is to be obtained. Lighting can be less dramatic, exposure must be somewhat more precise, colour temperature of the light source becomes an important factor, and it should always be borne in mind that colours seemingly similar to the eye may not appear so to the colour film. Laboratories must assimilate new methods of sensitometry, and extend their chemical control systems if the requisite standard for colour film processing is to be maintained. Unless these needs are recognized and met, disappointment will surely follow.

Acknowledgment

The author's thanks are due to Mr. J. A. Carter of the Kodak Research Laboratories for much helpful advice during the preparation of this paper.

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DISCUSSION

R. H. BOMBACK : I recognized the film projected as a print from a WarnerColor negative. Have you any comments on this ?

THE AUTHOR : Eastman Colour Films are used in the WarnerColor process.

W. LASSALLY : You said in your lecture that intercutting of the daylight and tungsten type colour negative was difficult. If this is so, what is the recommended procedure for intercutting exterior and interior scenes ?

THE AUTHOR : It is true that intercutting of 5247 and 5248 negatives is difficult on account of the difference in the coloured coupler density. As I explained, future production will probably be concentrated on the 5248 negative, with the intention that it should be used both for exteriors and interiors, with a suitable compensating filter in the case of exterior work.

W. S. BLAND : I notice that the preferred type of printer projects three separate beams through narrow

band filters for analysis of the light. These beams pass through different parts of the bulb and so will be subject to their different rates of blackening. Will this not upset the colour balance? In my experience lamps of this type are subject to rather rapid loss in light output through blackening of the bulb? bulb? What is the effective life of the lamp?

G. W. ASHTON : Possibly Mr. Bland did not realise from the diagram that the light reaching the printing aperture is automatically controlled to a pre-determined value by the photoelectric cell assembly. Therefore, change in light output due to blackening of the bulb is automatically compensated.

THE AUTHOR : That is true, but the question of the total lamp life must still remain a problem. At the present time this is secondary to the problem of getting sufficient exposure on the film.

R. L. HOULT : You mention that when using 5248 film in daylight a Wratten 85 filter is recommended for colour temperature correction. If 5248 is colour balanced for 3200°K, why is a Wratten 85B filter not recommended for this purpose?

THE AUTHOR : The Wratten 85 filter corrects to one colour temperature only. In practice colour temperature of daylight varies over a wide range, so that a correction at the printing stage is nearly always necessary. In these circumstances it does not much matter whether an 85 or an 85B filter is used.

Work is going on with a view to producing a series of colour correction filters intended for use with 5248 film. These will provide more specific colour correction under varying conditions of daylight.

I. B. M. LOMAS : In view of the amount of work which has been carried out on automatic masking methods in recent years, would it not be true to say that ideal subtractive dyes are impossible to obtain?

THE AUTHOR : I think it is reasonable to say that the attainment of ideal dyes in practice seems to be virtually impossible.

F. BUSH : The speaker has said that 5248 film is colour balanced for 3200°K, and that satisfactory results are obtainable at 3350°K. Could he say from experience what a practical lower limit to the colour temperature would be, while still maintaining reasonable exposure balance in the three emulsion layers.

THE AUTHOR : I have no practical experience on which to base an answer, but I would estimate it at 3000°K.

A MEMBER : Colour film for daylight use is usually balanced to Mean Noon Sunlight. Is it possible to correct, in the printing process, for daylight conditions other than this, so as to obtain a uniform effective colour temperature in the print?

THE AUTHOR : Certainly, some correction along these lines is possible, but I would not like to suggest that extreme conditions can be corrected in this way.

A MEMBER : Could you say if the Eastman Colour Films are likely to prove more economical than other types of colour processes in current use?

THE AUTHOR : The answer to this depends on the number of prints you wish to have. For quantity

production of release prints there are other methods which may well prove cheaper, but as the number of prints required decreases this discrepancy disappears, and may even go the other way.

S. GOOZEE : No mention was made by the speaker of a colour chart to be used when shooting with Eastman Colour Negative so as to provide the laboratory with a check on the actual exposure conditions. Is it intended to provide such a chart?

THE AUTHOR : Yes, a suitable chart will be made available in due course.

B. HONRI : Ealing Studios have used a reproduction of the Ilford colour chart on metal for underwater photography, using Eastman Colour Negative. At 25 feet or more, the chart (and everything in the water surrounding it) appeared greenish blue in the print but as the camera was brought nearer the chart the colour rendering improved until at a distance of five feet perfect colour rendering was obtained.

W. S. BLAND : What width of sound track may be used on Eastman Colour Print Film while still obtaining even density? I had the impression that the bead of developer might be hard to apply over a wide track in order to obtain a uniform density. What sort of dynamic range is obtainable from the Colour Print sound track?

THE AUTHOR : Undoubtedly some care is necessary in designing the applicator for sound track re-development, but no difficulty should be experienced in obtaining uniform re-development on standard tracks.

With regard to the dynamic range, I would refer you to the paper "Sound Track on Eastman Color Print Film," by C. H. Evans and J. F. Finkle, published in the August, 1951, issue of the *Journal of the Society of Motion Picture and Television Engineers*.

W. LASSALLY : Is any re-focusing of the camera lens necessary if Eastman Colour Negative is used in place of black-and-white negative?

THE AUTHOR : This might be necessary for really critical work.

B. TILL : In my experience, better colour quality is obtainable on colour films at large lens apertures as against small, say f/2.8 as against f/11. Is there any reason why neutral density filters should not be used so as to be able to work at large apertures in bright lighting conditions?

THE AUTHOR : I do not know why you should find better quality at large apertures, but certainly neutral density filters can be used to cut down the light, always remembering that such filters are seldom truly neutral. This fact may lead to printing complications if intercutting is necessary between negatives exposed in various cameras, using an assortment of neutral density filters. If only one neutral density filter is in use, there is no problem.

F. BUSH : With reference to the last question, at large lens aperture there is usually some image flare which lowers the overall contrast and desaturates the colours slightly. Generally speaking, the public

seems to prefer this quality to the more saturated higher contrast result obtained at small lens apertures.

P. W. DENNIS : Is there any theoretical or practical reason why coloured couplers as described should not be used in a reversal type film intended as a "master" from which copies are to be made ?

THE AUTHOR : I see no reason why coloured couplers should not be used in this way.

P. W. DENNIS : Will WarnerColor negatives made in America be printed on Eastman Colour Print Film in this country ?

THE AUTHOR : In America, prints from WarnerColor negatives are made on Eastman Colour Print Film. As this film may not be available in sufficient quantity in this country, it is difficult to say what may happen in this respect. Eastman Colour Negative Film is quite a flexible medium in the sense that other colour printing techniques can be employed apart from Eastman Colour Print Film.

S. IRVING : Why is it that lenses suitable for use in black-and-white photography may not be suitable for Eastman Colour Films ?

THE AUTHOR : This depends on the degree of colour correction in a given lens. Black-and-white films, especially if used with light filters, will not require such complete correction in the lens as do integral tripack colour films. A practical test with the particular lens and film is advisable.

A. HINDS : Are Eastman Colour Films easily obtainable ?

THE AUTHOR : Supply of the films in Great Britain is subject to a Board of Trade Import Licence. Whether this is granted will depend on the purpose the film is wanted for. So far as actual supplies are concerned, adequate quantities of all types should be available later this year.

MR. WILLIAMS : In order to avoid using internegative, would it be possible to introduce fades and so on by using A and B roll printing technique ?

THE AUTHOR : Yes, that should be quite possible. American practice, however, appears to be to make internegatives for all optical inserts.

W. LASSALLY : I thought that, apart from a slightly increased graininess, the internegative sequence we saw in the projected colour print matched extremely well with the sequence from the original negative.

Complete information on Eastman Colour Films is contained in the publication "Production of Motion Pictures in Color using Eastman Color Film." A copy is available for reference only in the Society's Library.



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Now, Studio Manager at Ealing Studios, Ltd., Baynham Honri is best known for his eagerness to examine and exploit fresh techniques and new processes. He will certainly have the opportunity to exercise this enthusiasm during his term of office, for the utmost vision will be required in resolving the manifold problems with which the industry is beset. In the work which lies ahead, the President may be assured of the best wishes and keen support of his fellow members.

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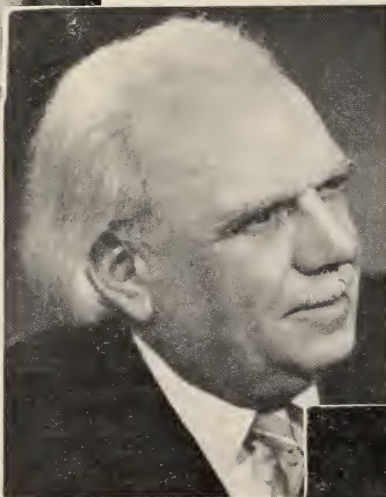
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O.B.E., Hon. F.R.P.S.

HON. FELLOWSHIP CITATIONS

André Debrie

M. André Debrie has been a leading personality in French cinematography for over 45 years, and has been responsible for the design and development of many special-purpose cameras, of laboratory equipment

and of projectors.

The Hon. Fellowship is awarded in recognition of the valuable contributions he has made to the advancement of cinematography.

George William Pearson, O.B.E., Hon. F.R.P.S.

Mr. G. W. Pearson occupied a responsible position in film production in 1913, and since that date he has shown outstanding originality of thought in the development of motion picture technology. He was the first to develop the use of enclosed arcs and mercury vapour lamps for studio lighting, and subse-

quently to introduce contre-par and other effective means of lighting, which, combined with greater camera flexibility, laid the foundation of present techniques of film making.

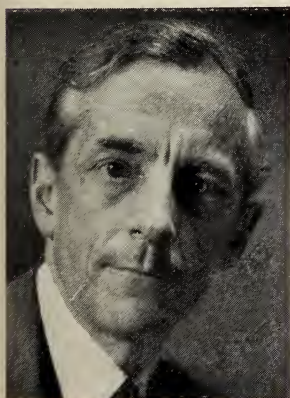
The Hon. Fellowship is awarded as a token of appreciation of the service he has rendered to British cinematography.

Leslie Knopp, M.B.E., Ph.D., M.Sc., M.I.N.A.

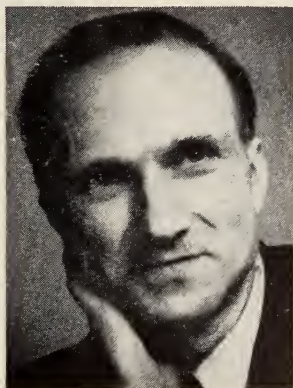
The Hon. Fellowship is awarded to Dr. Leslie Knopp, for his invaluable and unremitting service to the art and science of

cinematography and to the British Kinematograph Society.

FELLOWS



Geoffrey Stanley Moore,
B.Sc., M.Sc., F.R.P.S.



Charles Vinten



Denis Ward,
Ph.D., B.Sc., F.R.P.S.

FELLOWSHIP CITATIONS

Geoffrey Stanley Moore, B.Sc., M.Sc., F.R.P.S.

Mr. G. S. Moore is known internationally for his work in the field of photographic sensitometry and for his researches on latensification. His investigations of hypersensitizing and of the reciprocity law failure have been

of considerable value to cinematography in all its applications.

The Fellowship is awarded for his keen application to these matters and the outstanding success he has achieved.

Charles Vinten

For a period of over 25 years Mr. Vinten has been engaged in the design and development of cinematograph equipment, and the value of his work is recognized both in this

country and in the U.S.A.

The Fellowship is awarded particularly for the developments in camera design for which he has personally been responsible.

Denis Ward, Ph.D., B.Sc., F.R.P.S.

Dr. Ward has produced a number of specialized films of exceptional high quality, which have been received both in this country and abroad as outstanding examples of cinematograph technique. During the last ten years Dr. Ward has, by improved production methods, advanced the quality of colour films, and these improved methods have been

made generally available through the papers he has presented to the Society and his other contributions.

The Fellowship is awarded in recognition of these advances, and for his contribution to the progress of the Society since he has been Chairman of the 16mm. Film Division.

NEWMAN MEMORIAL AWARD

The Councils of the Royal Photographic Society of Great Britain and The British Kinematograph Society have unanimously agreed that a Newman Memorial Award be presented to Mr. Norman Leever, B.Sc., A.C.G.I. (Fellow), for his research into and development of cinematographic techniques and mechanics and, in particular, for his novel "Syncropulse" system which provides the means for establishing the precise synchronization of motion picture and sound records, notwithstanding non-synchronism of the driving mechanisms of cameras and of sound recording apparatus.

Mr. Leever has shown keen appreciation of the mechanical and electrical systems of cinematograph equipment, and his system is being used successfully in the motion picture industry both at home and abroad.



Norman Leever,
B.Sc., A.C.G.I. (Fellow)

SOCIETY DINNER

THE social functions of the Society have always been famous for the wide representation of interests to be found among the guests. The Dinner on April 14 at the Savoy Hotel proved no exception to the tradition, when 350 guests were present and personalities from all sections of the industry entered, with enthusiasm, into what turned out to be both an interesting and enjoyable evening.

In proposing the toast of the Society, Mr. J. W. Davies, President of the Cinematograph Exhibitors' Association of Great Britain and Ireland, gave emphasis to the valuable contribution to the advancement of the science and technology of cinematography which had been made through the Society's educational work.

The future, with the advent of three-dimensional and panoramic screen projects, would provide opportunity for the Society to be of even greater service than before. Whether it be in production, in processing or in exhibition, the proposed new techniques would provide scope for research, scientific improvisation and standardization.

In responding to the toast, Dr. Leslie Knopp, the Society's President, spoke of the intention to extend the courses of instruction and raise them to a higher technical standard. It was hoped to raise the standard of efficiency and economy in picture presentation and to include in the curriculum lectures on the modern developments of three-dimensional and panoramic picture presentation.

Attention was drawn to the fact that although industry and commerce had for long supported research organizations which were found to be sound and profitable, the large British cinema industry was without such an undertaking. With comparatively little expenditure upon properly organized and directed

research, results which could have lasting benefits might be achieved.

The Society was preparing a comprehensive report on the principles of stereoptics and stereography and the problems involved in stereo cinematography. It was intended to give producers and camera operators guidance as to how to avoid the glaring faults of linear distortion and mis-placements in space relationships, and to point out the secondary physical and psychological relationships that must be observed to preserve comfortable and, as far as possible, natural viewing conditions.

It was hoped to deal with some of the laboratory problems, the proper co-relation of analogous points and image pairs, and suitable alignment to meet average conditions of projection: some of the new problems the renter would have to face would be included; the examination and checking for synchronism of paired copies, their identification and perhaps new standards of reel lengths: for exhibitors it was intended to investigate the alignment and synchronism of projectors, new standards for spools, modifications of screens and the like.

Finally, and perhaps of greater importance, close liaison would be kept with colleagues in America and on the Continent in an endeavour to maintain adequate standards so that all films would be universal in their application.

Dr. Knopp introduced a note of warning, that the Society was not financially strong and might find it necessary to ask for assistance to complete the task.

Mr. Baynham Honri, the Vice-President, of the Society, proposed the toast of the guests and Major R. P. Baker, President of the British Film Producers' Association, responded briefly.

THE FLAMMABILITY AND FLASH POINT OF CELLULOSE ACETATE FILM CONTAINING VARIOUS AMOUNTS OF CELLULOSE NITRATE

By R. W. Pickard, B.Sc.,* and D. Hird, B.Sc.*

THE work described in this paper was carried out at the request of a British Standards Institution Technical Committee on the "Inflammability of Safety Film." The effect which introducing different amounts of cellulose nitrate would have on the flash point and flammability of safety film was investigated. A surface coating of cellulose nitrate is at present only occasionally used, but future developments in the film manufacturing industry might call for the wider use of surface coatings and even the

inclusion of small amounts of cellulose nitrate in the body of the safety film base.

Specially prepared film containing amounts up to 16 per cent. of cellulose nitrate both in the base and as a surface coating were tested. The actual cellulose nitrate contents used are shown in Table I.

Flammability Tests

The apparatus used in the flammability test¹ consisted of two steel supports in the form of a 14-in. diameter semicircle, mounted on a base with their adjacent edges 1 in. apart. A 21-in. length of film was held in position over

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Table I
FLAMMABILITY AND FLASH POINT DETERMINATIONS

Specimen	Thickness in. $\times 10^3$	Mean distance of flame spread (in.)	Flash point C.
Cellulose triacetate safety base	5.3	Film did not continue to burn after the alcohol flame had burnt out	305
3% cellulose nitrate as mixture with cellulose triacetate base	5.7	Film did not continue to burn after the alcohol flame had burnt out	220
6.5% cellulose nitrate as mixture with cellulose triacetate base	5.5	Film did not continue to burn after the alcohol flame had burnt out	206
12% cellulose nitrate as mixture with cellulose triacetate base	5.0	5.0	—
16% cellulose nitrate as mixture with cellulose triacetate base	4.0	6.0	210
4% cellulose nitrate as surface coating on both sides of cellulose triacetate base	5.8	Film did not continue to burn after the alcohol flame had burnt out	186
9% cellulose nitrate as surface coating on both sides of cellulose triacetate base	6.5	10.0	182
14.5% cellulose nitrate as surface coating on both sides of cellulose triacetate base	6.7	19.5	162
Cartridge paper	7.6	19.5	288

* Department of Scientific and Industrial Research and Fire Offices' Committee Joint Fire Research Organization.

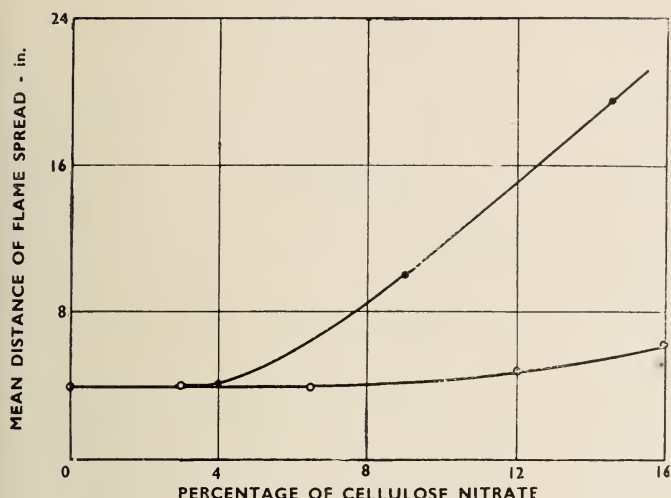


Fig. 1.
Distance of spread of flame as a function of the cellulose nitrate content. (○—cellulose nitrate as mixture with base, ●—cellulose nitrate as surface coating on base.)

the supports by two thin steel strips, and ignited at one end. The distance over which the film burnt was taken as a measure of its flammability. In previous work on the development of this flammability test many different types of safety film as well as samples of paper, cotton, rayon and nitrate film were tested. None of the samples of safety film burnt over a distance greater than 16 in., whereas samples of nitrate film, some newsprints, cotton and rayon were still burning at 21 in.

In the present series of tests six samples of each type of film were tested on the apparatus and the results are shown in Table I.

Fig. 1 shows the mean distance of spread of flame plotted as a function of the cellulose nitrate content. A flame spread of 4 in. indicates that the film did not continue to burn after the alcohol flame had burnt out.

It would appear from this that a cellulose nitrate content of up to 4 per cent, either as a surface coating or as a mixture with the base, does not increase the flammability of the film appreciably. Higher cellulose nitrate contents, up to concentrations of 16 per cent, in the body of the base cause little increase in its flammability. However, if higher cellulose nitrate contents are present as a surface coating then a marked increase in the flammability is observed. With 14.5 per cent cellulose nitrate present as a surface coating, the film was still burning after a distance of 21 in., and was thus more flammable than any type of safety film. A probable explanation of the difference in behaviour of the film with the nitrate in the base and as a surface coating may be that if the cellulose nitrate surface coating is thick enough, the film assumes the highly flammable characteristics of cellulose nitrate. However, within the limits of these

Fig. 2
The time-temperature curves when the specimen was triacetate base with 14.5 per cent cellulose nitrate as surface coating.

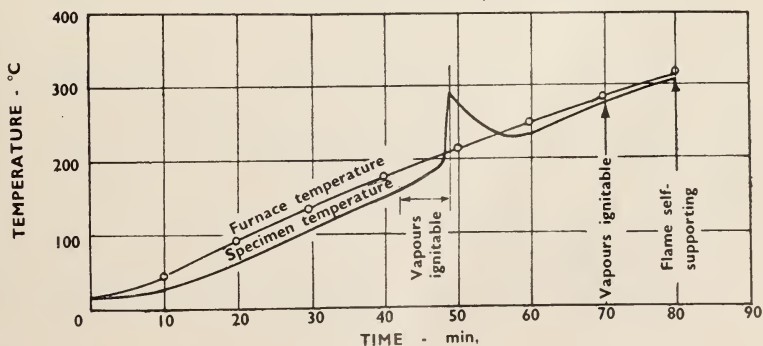
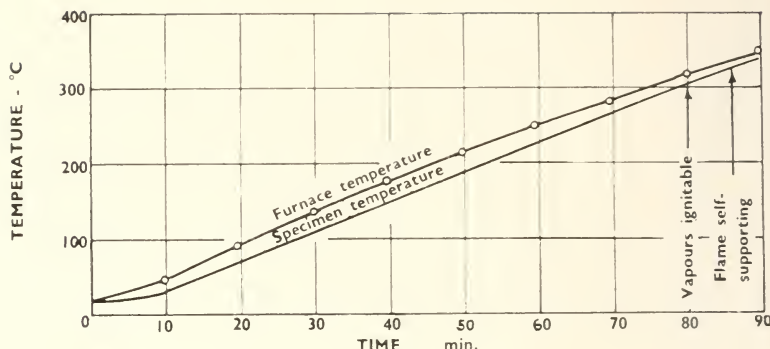


Fig. 3.

The time-temperature curves when the specimen was triacetate safety base.



tests the concentration is not high enough with the nitrate present in the body of the base to increase the flammability appreciably.

It can be seen from Table I that the untreated safety base did not continue to burn after the alcohol flame had burnt out. With a more flammable safety base a given nitrate content would result in a more flammable film than indicated in Fig. 1.

Flash Point Determinations

The flash point of a liquid or volatile solid is the temperature at which it gives off sufficient vapours to form an ignitable mixture with air near the surface of the material. The "flash point" of film is defined in this paper similarly, although the vapours given off by the film on heating are decomposition products. Materials in the neighbourhood of a fire are gradually heated and the spread of fire is often facilitated if these materials give off vapours which are ignitable. It was felt, therefore, that the "flash point" of the films was a better measure of the fire hazard than the ignition temperature.

To determine the flash point of the speci-

mens of film under test a fixed weight of film (in this case 3.7 grammes), in the form of punchings $\frac{1}{2}$ cm. square, was placed in a test-tube and one junction of a platinum-platinum-rhodium thermocouple placed in the centre of the specimen. The other junction of the thermocouple was placed in a Dewar flask. The test-tube was supported in a small electric furnace, the temperature of which was raised at about $4^{\circ}\text{C}/\text{min.}$ The temperature of the furnace could be measured by a mercury in glass thermometer in the furnace wall. A small pilot flame was mounted over the top of the test-tube to ignite the vapours when they were given off in a sufficient quantity.

A representative selection of the films, containing different amounts of cellulose nitrate, was tested in this manner, as well as a normal safety film base and a sample of cartridge paper. The specimens of film which contained cellulose nitrate, either as a surface coating or in the base, behaved similarly, and a typical graph of specimen and furnace temperature is shown in Fig. 2. In this case the flash point was 160°C. the vapours being

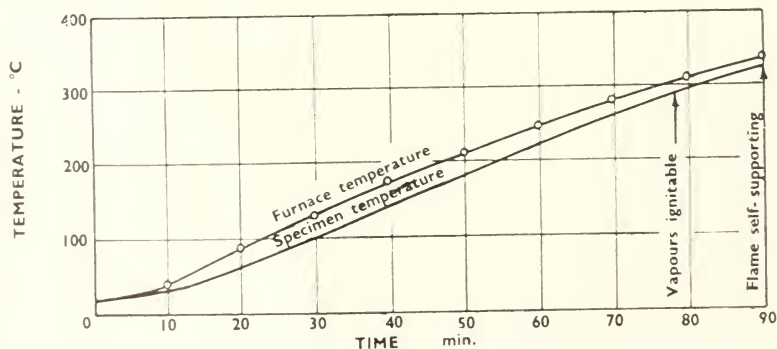


Fig. 4.

The time-temperature curves when the specimen was cartridge paper.

first ignitable and the subsequent flame travelling down the test-tube at this temperature. After some 4 or 5 minutes the temperature of the film increased rapidly, denoting an exothermic reaction, and on ignition the vapours burnt with a self-supporting flame. Soon after this the flame died out, the vapours were no longer ignitable, and the temperature of the specimen fell to below the temperature of the furnace again. The tests showed that the severity of the exothermic reaction increased as the percentage of cellulose nitrate increased. As the temperature of the furnace was raised further ignitable vapours were again given off. This occurred at about 280°C, although in this case there was no exothermic reaction. Some 8 to 10 minutes after this second flash point the flames became self-supporting.

Fig. 3 shows the temperature graphs for the triacetate base used in the film samples containing cellulose nitrate, and Fig. 4 those for cartridge paper. The flash points which were determined are shown in Table I. In those films containing any cellulose nitrate, the nitrate decomposed at a lower temperature than the rest of the base giving ignitable vapours at temperatures between 160 and 220°C. The second flash point of these films was due to the decomposition of the base, at temperatures in the range 270 to 300°C.

It is known that nitrate film is unstable to some degree under normal conditions.² As the film deteriorates with age it is likely that the flash point will be lowered. It would seem

probable therefore that with films containing any cellulose nitrate there will be some slight risk of instability and deterioration which might cause a lowering of the flash point.

Conclusions

Within the limits of concentration used in these tests, the inclusion of cellulose nitrate in the body of the safety film base did not appreciably increase the flammability. With the cellulose nitrate present as a surface coating, however, the flammability increased as the percentage of nitrate present increased.

The presence of cellulose nitrate in either form leads to a considerable reduction in the flash point. Thus under certain conditions, for instance in a closed or poorly ventilated space, a flammable mixture of gases would be obtained at a lower temperature than with film containing no cellulose nitrate.

Acknowledgments

The work described in this paper forms part of the programme of the Joint Fire Research Organization of the Department of Scientific and Industrial Research and Fire Offices' Committee; the paper is published by permission of the Director of Fire Research.

The authors wish to express their indebtedness to Ilford, Ltd., for specially preparing and supplying the samples of film used in these tests. Thanks are also due to Mr. P. C. Bowes for many helpful suggestions during the flash point determinations.

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PRODUCTION TECHNIQUES IN THE MAKING OF EDUCATIONAL FILMS

Frank A. Hoare (Member)

Read to a meeting of the British Kinematograph Society on February 4, 1953

THE purpose of this paper is to focus attention on those aspects of production technique which contribute towards the greater educational effectiveness of teaching films.

An educational film must have specific educational functions, must be related to what is taught in schools or courses of training and is normally designed to be used in conjunction with other methods of teaching.

An educational film, therefore, is not merely a good or an interesting film: it is primarily something to be used as a tool in the hands of the teacher or instructor. It is now commonplace to say it cannot replace the teacher and its real effectiveness depends very largely on the use made of it.

While it is true that a film seen by a pupil or student can, of itself, teach something the degree of learning depending on the capacity and receptiveness of the individual, there is general agreement that the film is a visual aid which must be integrated into the technique of teaching by a highly skilled person who understands the processes involved.

There are a few other general considerations which should perhaps be listed at the outset.

Firstly, the film is not designed "to teach subject" but it deals with those aspects of a subject which can be put over only, or more effectively, by the motion picture than by other ways of teaching. It follows that the film will always leave a good deal unsaid; gaps to be filled in by the teacher or by other forms of study.

Secondly, the time factor exercises a considerable control on the topic and length of a film. In school education, there is little value in dealing with subjects outside the normal school curriculum. With courses of

training in industry the choice of subjects is narrowed down to a field within the prescribed course of study.

The time factor is also relevant to the total period available in a term or a year for teaching a given subject. Normally, a lesson period will not exceed 45 minutes and, given two periods per week and a school year of, say, 36 weeks, the teacher has only 54 hours in a year to cover his syllabus. He will therefore, only make use of a film when its educational value fully justifies the expenditure of time.

The time factor must be considered in relation to the optimum length of an educational film. A film normally needs to be shown twice in a lesson period and consequently the most popular length is 8-10 minutes, though in some cases 15-20 minutes is acceptable.

This paper is concerned with the didactic film which sets out to put over a series of related facts in the field of science, geography, or physiology or in some industrial process. Educational films can do more than that: they can enlarge experience, for example, by giving a vivid impression of life and work in a community of which the viewer has no first-hand experience. (A good example of this kind of film is *Cyprus is an Island* which was not made specifically for educational purposes.) They can be used to revise facts already learnt or to stimulate further enquiry and research. The world famous series *Secrets of Nature* must have created in many people, young and old, a desire to learn more about natural history and biology. It should never be forgotten that the greatest power of the film is its emotional effect; its power to change or develop what the Americans call "attitudes." Two recent

examples of films in this category are Larkins' *Without Fear*, showing the dangers of totalitarianism, and Norman McLaren's *Neighbours*. In this last category it is clear that the better the film the more profound and lasting will be its emotional effect.

The field is obviously a large one whether in terms of subjects or instructional objectives and, therefore, the present paper will be largely considerations of the production problems involved in making more effective films to teach processes and skills conveying factual information and to increase personal knowledge.

The film technician, presented with a topic, almost invariably tends to think in terms of film as an art. He reads a story, sees an incident or watches a process, and his mind transmutes it into motion pictures—he is concerned with pattern as much as with content. The instructor on the other hand, tends to think of the film as a useful adjunct to a verbal lesson; his viewpoint is a literary one and he is not interested in visual pattern and is suspicious of film as art. Hence some documentary-instructionals tend to be sophisticated and mannered and many classroom films are rather drab and pedestrian. It is probably true that the prevailing emphasis on the film as an "extension of the blackboard" has tended to diminish the function of the film to stimulate and awaken. In the latter case the manner of its making and its artistic quality are obviously of first importance in relation to its emotional appeal.

On this broad distinction between the strictly pedagogic and the stimulating film we can proceed to more detailed considerations affecting the film technician. Standards of writing, direction and editing are much the same whether the film is for use in the classroom, in industry or in the Services. We are using a film rather than some other medium because the film gives a clearer demonstration. There is little or no art about it, and the essence is the bare bones of the subject presented in logical sequence with no distracting irrelevances. Such films, well or badly done, are, in their essence, simple to make and not expensive.

In considering the problems of production technique in relation to instructional effectiveness, factors other than the quality of the film itself are involved. For example, the film must be made to meet the characteristics of a typical audience or student whereas, in fact, no typical audience or student really exists. The teaching procedures that accompany the use of the film vary in effectiveness and all too often the quality of the projection falls below the standard assumed by the production team when the film is made.

Film technicians can obviously only concern themselves with the content and structure of the film, combining motion pictures, speech, music, charts and diagrams to produce the most effective whole. Other aspects of instructional effectiveness fall outside their sphere and are in the hands of teachers and instructors—most of whom are keen to get the utmost value out of this medium of instruction.

The following paragraphs deal with more or less precise production techniques though not in any particular order of importance or significance.

Rate of Development

A slow rate of development in a film is more effective than a rapid one but in nearly all training and educational films the tempo could with advantage be slower. It is important that the subject be built up logically, step by step, and that continuity be clear and precise. Each sequence must remain on the screen long enough for the student to grasp it thoroughly, and the director should avoid quick cutting, flash pans, "fancy" wipes and other devices designed to speed up action. The tendency to pack a large amount of instructional material into a short film must be resisted. It defeats its own objective which is more learning in less time. The comparatively expensive nature of the film medium makes people think that overcrowded and fast action will help to justify the cost, but this is a complete fallacy and probably derives from the current practice in entertainment films. Our object is to teach, to enable people to acquire factual knowledge

and skills and to develop personal attitudes and opinions.

The function of the editor is an important one in relation to tempo. The intention of the director to maintain a steady rhythm and a clear logical development in his film can be entirely frustrated by a lack of understanding by the editor of the importance of this objective. This does not mean that the editor has little or no contribution to make. However good the script and the direction, improvement can come from re-arrangement of sequences or parts of sequences. A too rigid adherence to the pre-conceptions of the script in these circumstances will clearly have to be avoided. But the editor must be in general agreement with the view that for instructional effectiveness the tempo should be slow and with a rhythm which is clearly established throughout individual sequences and throughout the film as a whole.

Repetition

To some extent the dangers arising from a too quick tempo can be overcome by repetition, but in any case repetition is an important instructional device. Apart from repeated showings of the film, repetition of a sequence which may be difficult to follow is desirable. Here again, as in the case of slow tempo, there is often resistance from the film technicians on artistic or aesthetic grounds. The primary object of the producer of an instructional film is to teach and not to produce a work of art; if he succeeds in doing both so much the better, for there is nothing mutually exclusive in these two aspects of film making. It is a good plan, having described a sequence, for the commentator to say—"Watch it happen again"—and then to keep quiet while it is shown.

Amount of Commentary

This leads to a consideration of the amount of commentary desirable in an instructional film. Many films are far too tightly packed with commentary for effective results, so that the pace of speaking is too quick and there are no pauses for the eye to concentrate on the visual action. The commentator should speak at a normal conversational pace—

sentences should be clear and short and generally should deal with one thought only. There is a tendency, which must be firmly resisted, for people to insist that points which cannot be made in visual form be covered by additions to the commentary. This is one of the main reasons for overloading and it is disastrous from every point of view. The mixing of commentary with background music is to be avoided and, where effects are necessary, they should run clear of the commentary and not be mixed with it. This is particularly important when you bear in mind that the completed film, having been reduced to 16mm. form, will be projected in the classroom on an old machine, by an inexperienced projectionist, in indifferent blackout and in a room where acoustic conditions are poor.

Use of Camera

The best instructional films are those with clear well lit visuals and good picture composition, in which the camera concentrates attention on the essential point to be observed. Unusual angle shots, so beloved by some cameramen, are bewildering to young people who can easily lose the instructional line of thought. It is often found that panning is confusing unless there is a recognisable object to follow throughout. Camera tricks—as distinct from clever use of the camera—and "arty" optical devices have no place in the instructional film, the main characteristic of which must always be simplicity. This does not mean a dull pedestrianism; quite the contrary, for the achievement of simplicity in film making calls for the highest degree of skill and knowledge of the medium as well as of the subject being filmed.

While long shots have their place, particularly as establishing shots, closer shots are generally better as they help to rivet the attention on essentials. The use of an occasional long shot sometimes gives a much-needed moment or two of "rest" from the hard thinking and concentration in which the viewer is involved.

A shot with excellent photographic or artistic qualities does not justify its place in an

educational film unless it reveals some essential point in the subject. All too often shots are left in the picture as an easy way out when their proper place is in the bin. Perhaps that is why we so often see shots of cranes lifting bales out of a ship's hold, or shots of machinery merely whirling round. These visual clichés are far too common and usually indicate that the film maker is bankrupt of ideas. Nothing is more damaging to instructional effectiveness than shots which have no significance in the subject to be taught but are included to satisfy the cameraman's ego. Every shot should be examined to see if it contributes vitally to an understanding of the subject ; if not, it should be rejected, however alluring it may be.

In certain types of film, such as those for teaching a process or some form of manual dexterity, it is often better to place the camera in the position of the person performing the task rather than, as is more common, in that of the observer opposite him. This has been described as the 0° camera angle as distinct from the 180° camera angle. Further experimental work might well be done on this aspect of the cameraman's task.

The camera has the most important role to play in the making of effective instructional films, for effectiveness depends primarily on the strength of the visual presentation and to a much lesser degree on the commentary. If the pictorial presentation is not the essential part of the instruction there can be no justification for the trouble and expense of making the film.

Use of Colour

Since comparatively few instructional films have been made in colour, due to the higher cost factor involved, it is unsafe to draw general conclusions about the contribution which colour can make to instructional effectiveness. Although it is undoubtedly popular with students some people regard colour as a distraction. There can be no doubt, however, that it reinforces the visual effect when colour appreciation forms part of the subject ; for example, in the E.D.A. film *Electricity and Light* dealing with electrical discharge forms of lighting.

Another good example of the value of colour is the recent series of films by the Shell Unit on the life cycle of three pests—red spider, winter moth and raspberry beetle. Here, colour is a real aid to the recognition of pests, from larvae to maturity, especially when, as in this case, it is supported by authentic coloured backgrounds.

There is much to be said for the use of colour in animated diagram work and maps, where otherwise one must rely on varying tones in black and white to differentiate the several component parts. Of the comparative effectiveness of colour and black-and-white, however, judged from the instructional angle, little can be said until there has been an opportunity for further research and experiment.

Negative Teaching

A fruitful topic for argument is the desirability or otherwise of teaching by showing the wrong way—in fact, how *not* to do it ! This problem frequently arises when the film is intended to demonstrate a fairly complex skilled operation ; for example, the use of a lathe, or some athletic activity such as bowling or batting. The consensus of opinion seems to be that it is better to illustrate the correct way, but there is a strong minority opinion which holds that it is desirable to show the errors a beginner is likely to make in learning to perform a task. It is obviously most important that the final impression conveyed should be the correct way. This is exemplified in the E.F.V.A. film *Cricket Batting Strokes*, where the instructor moves among his class correcting positions and demonstrating the proper stance, position of arms and feet and the holding of the bat.

Cartoon and Diagram v. Live Photography

Improved techniques in the making of animated drawings assist greatly in making instructional films more effective. There is no rivalry between this form and live photography, for there is a place for both. Notably, the use of diagrams enables much clearer teaching to be given in Science, Geography and several other subjects. For example, in presenting studies of Electricity

and the behaviour of free moving electrons, the diagram makes an imaginative contribution of unique character. Recently, in describing the chemical processes of a blast furnace, a carefully planned series of simple diagrams enabled trainees who had had little science teaching at school and little idea of atomic theory, to grasp the essential principles involved without difficulty. Great care needs to be exercised because of two fairly obvious dangers. The first is the danger of oversimplification. A cleverly conceived diagram may convey the impression that a specific scientific phenomenon can be simply explained, whereas in fact there is more to it than appears to be the case. The other danger is that the instructional film may create the impression that an understanding of complicated scientific processes can be acquired easily and without considerable mental effort and study.

This can easily and unexpectedly arise through the use of the analogy: the pupil may thoroughly understand the analogy without being able to transfer his understanding to the subject. Many examples of this will spring to mind—cartoon figures to illustrate the pressure of voltage, or the varying strengths of electrical resistances, and the familiar figure of the horse and plough when discussing horse-power. Perhaps an even bigger danger is the false analogy—water flowing in a pipe to convey an understanding of the behaviour of electric current—though this is now largely a thing of the past.

Having made these reservations it would only be fair to add that the use of animated diagram and cartoon in instructional films is to-day one of the greatest means for effective teaching yet devised. Diagrams often provide that element of assistance which enables a student to grasp the basic principles of a difficult theory or process so that he is able to go forward much more successfully.

It is relevant here to refer to model work which is closely allied to diagram and cartoon. Sometimes it is more effective to use models because a clearer conception of actuality is obtained. The use of models in the film *The Nature of Plastics* to teach the basic facts

of the structure of plastics, and the model sequences in the Shell Unit film on the principles of oil refining processes by catalytic cracking plant are excellent examples of this technique.

The technical questions involved in producing good diagrammatic cartoon and model work are worthy of a separate paper, but one or two guiding principles can be mentioned.

Simplicity and clarity are of first importance. It is a mistake to attempt too much animation at the same time, as the eye cannot follow it. The action should be built up from first principles, step by step, until the whole process is depicted. Never be afraid of repeating the action two, or, if necessary, three times, and allow each sequence sufficient length to ensure that it is completely grasped before the next sequence begins. The rate of development or tempo of diagram sequences should invariably be quite slow and deliberate if the fullest possible teaching value is to be obtained.

Pre-Production Planning

More instructional films fail through inadequate pre-production planning than from any other cause. A clear definition of the subject matter and of the ultimate use of the film are of primary importance. The essential prerequisite to success is the preparation of a detailed shooting script in which every scene and every word is justified by its value to the whole.

The film must have a single, well-defined purpose. Failure accompanies attempts to make a film fulfil two or three different functions for a similar number of different audiences.

A great deal has already been written on effective collaboration in scripting an educational film. The film technician must work in harmony with an experienced teacher and often with a qualified subject specialist; but effective films cannot be made by committees, and once the scope and content have been worked out and questions of technical accuracy have been settled, the film makers should have the utmost freedom in deciding all those creative and technical matters involved in translating the script into

a motion picture. Many educational films show signs of having been over-supervised to meet the lowest common measure of agreement among the parties concerned. This is fatal to the making of teaching films ; but the claim which this paper makes for the freedom of the film technician presupposes that he justifies such confidence. He must keep abreast of the developing techniques of teaching ; he should see for himself how his films are being used by teachers and how the class responds to them. He must be recep-

tive to suggestion and advice while not necessarily always accepting the latter ; in which event he must display great diplomacy and tact.

The most effective educational films are those made by the team work of skilled craftsmen inspired by a sense of the worthwhileness of their task and of its value in training the next generation to live full and satisfying lives.

Excerpts were screened from a number of films to illustrate points made in the paper.

NEW EQUIPMENT

As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of news items does not constitute an endorsement.

CINEMA EMERGENCY LIGHTING

Pritchett & Gold & E.P.S. Co. Ltd., famous for their emergency lighting systems in hospitals and scientific establishments, are probably less well-known for their similar installations in the entertainment world. The P. & G. glass-box, sealed top battery is a superb example of craftsmanship and certainly the easiest type to service. The company's catalogue of maintained and non-maintained emergency lighting will be of great interest to all Theatre Division members.

Pritchett & Gold and E.P.S. Co. Ltd.,
137 Victoria Street,
London, S.W.1.

MAGNETIC RECORDING TAPES AND STRIPING SERVICE

The Minnisota Mining & Manufacturing Co. Ltd., makers of "Scotch Boy" tape, now supply 35mm., 17.5mm., and 16mm. cellulose-acetate film with full width magnetic coatings inside the perforations. The company is also about to introduce a 16mm. Film Striping Service. A full width (0.10 ins.) coating, together with a balancing stripe will first be offered although a half-stripe service will be announced later. The charge is 1½d. per foot, with a minimum charge of £2 per reel. Splice-free copies are advised.

The Minnisota Mining & Manufacturing
Co. Ltd.
167 Strand,
London, W.C.2.

MONITOR CATHODE-RAY TUBE

The manufacturers of Emitron valves announce a small cathode-ray tube for incorporation into electronic circuits for wave-shape monitoring. In appearance not unlike a normal lock-in valve, it has a 1-inch diameter screen. The tube, known as ICPI, retails at only £1 17s. 6d., and will find many users in the sound recording field.

Electronic Tubes, Ltd.
Kingsmead Works,
High Wycombe,
Buckinghamshire.

POWER FACTOR AND WATTAGE UNIT

A power factor and wattage unit has been designed for use with commercial A.C. supplies from below 100v. to 450v. From readings taken with an AvoMeter used in association with the unit, power factor and A.C. power can be determined in single phase and balanced or unbalanced two or three phase circuits.

One very great advantage of the unit is its ability to produce very low power readings unobtainable with the usual dynamometer wattmeter.

Automatic Coil Winder & Electrical
Equipment Co. Ltd.
Winder House,
Douglas Street,
London, S.W.1.

TECHNICAL ABSTRACTS

SOUND-ON-FILM RECORDING USING ELECTRO-OPTIC CRYSTAL TECHNIQUES

Dressler, R., and Chesnes, A. A., *J. Soc. Mot. Pic. & Tel. Eng.*, **60**, 205, 1953.

This paper deals with the theoretical and practical aspects of a sound-on-film recorder with no moving parts, utilizing the birefringence properties of certain crystals. The physical properties of various crystals, as well as final performance measurements of the entire sound system, are discussed.

AUTHORS' ABSTRACT.

AN INTERMEDIATE POSITIVE-NEGATIVE SYSTEM FOR COLOUR MOTION PICTURE PHOTOGRAPHY

Anderson, C. R., Groet, N. H., Horton, C. A., and Zwick, D. M. *Ibid*, 217.

A colour printing system for motion pictures is outlined employing : Eastman Colour Negative Safety Film, Type 5247 ; Eastman Separation Panchromatic Safety Film, Type 5216 ; Eastman Colour Internegative Safety Film, Type 5243 ; and Eastman Colour Print Safety Film, Type 5381. The sensitometric characteristics of the two intermediate materials are described. Some methods of using them and the problems involved in colour registration printing are discussed.

AUTHORS' ABSTRACT.

KINESCOPE RECORDING FILM EXPOSURE CONTROL

Lovell, R. E., and Fraser, R. M. *Ibid*, 226.

Various devices have been perfected to control accurately the exposure of video pictures to be recorded on motion picture film. These devices, combined with sensitometric control, take much of the guesswork out of the kinescope recording process.

AUTHORS' ABSTRACT.

HISTORY AND PRESENT POSITION OF HIGH-SPEED PHOTOGRAPHY IN GREAT BRITAIN

Chesterman, W. D. *Ibid*, 240.

The history of high-speed photography in Great Britain is outlined, beginning with intermediate-rate cameras, defined as those in which the film is transported continuously through the camera mechanism at speeds not exceeding 40 m/sec. Then follows a survey of drum cameras, in which a single loop of film is transported at speeds up to 240 m/sec. on a rotating drum, or where images are swept along the stationary film at this rate by moving optical parts. Recent developments in light sources of short duration are discussed and the review concludes with a description of some research studies in zoological biological and medical researches, and some recent military applications.

AUTHOR'S ABSTRACT.

PRECISION FILM EDITOR UTILIZING NON-INTERMITTENT PROJECTION

Johnke, T. *Ibid*, 253.

Maximum efficiency in editing film both in production studios and in television stations is the objective of a recently developed preview-and-editing machine which utilizes a continuous projection process in place of the customary intermittent movement and shutter. Because projection is continuous, and because all parts are machined that no portion of the film except the sprocket hole area ever comes into contact with any surface, valuable originals and fine-grain masters can be edited safely on this machine.

AUTHOR'S ABSTRACT.

THE BRIDGAMATIC DEVELOPING MACHINE

Tanney, J. A., and Krause, E. B. *Ibid*, 260.

A need was felt for a reasonably priced, quickly accessible, self-contained automatic film processor for television stations and small laboratories. This led to the design of the Bridgomatic machine which embodies standard commercial design plus a continuous overdrive, tension-relieving devices, straightline film flow and ease of handling. 16mm. and 35mm. negative-positive and reversal models are described. The add-a-unit idea was adopted, so the bare machine can later be equipped with whatever refinements are desired.

AUTHORS' ABSTRACT.

THE STEREOSCOPIC ART.

Norling, J. A., *P.S.A. Journal*, Nov./Dec., 1951, and Jan./Feb., 1952.

An accelerated interest in stereoscopic photography has been inspired in recent years by the appearance of compact, well designed cameras and viewing devices marketed at moderate prices. These new products and their increasingly widespread use support the belief that any art such as stereoscopic representation depends for popularity, indeed for survival, on the equipment available to enable people to practice the art.

AUTHOR'S ABSTRACT.

RECOMMENDATIONS OF THE NATIONAL TELEVISION SYSTEM COMMITTEE FOR A COLOUR TELEVISION SIGNAL

Loughren, A. V., *J. Soc. Mot. Pic. & Tel. Eng.*, **60**, 321, 1953.

EIDOPHOR SYSTEM OF THEATRE TELEVISIONSponable, E. I. *Ibid*, 337.

The Eidophor, or Fischer, theatre television system is described in an introductory way, then as installed at the Twentieth Century-Fox home office theatre a year ago for exhibition shows for exhibitors and the press.

AUTHOR'S ABSTRACT.

SYNCHRO-LITE POWERED 16mm. PROJECTORPutman, R. E., and Ledener, E. H. *Ibid*, 385.

A new flashtube arrangement, providing projection light for television reproduction from film, is here described in detail. It ensures accurate and permanent synchronization of light pulse with intermittent pulldown. Further, since both the intermittent movement and the flashing lamp are controlled by the television vertical pulse, the mechanism can readily be interlocked with other picture sources for interpolation, laps and fades. Travel ghost resulting from movement of film while the light pulse is on is made more impossible by the design.

AUTHORS' ABSTRACT.

A NEW PROFESSIONAL TELEVISION PROJECTORStewart, W. E. *Ibid*, 390.

A new professional projector specifically designed to meet television needs, which features a high-fidelity sound system with fast stabilization time, is described. A 2-3 pulldown system is incorporated especially for television. All gearing runs in oil and gears and other mechanical parts are designed for long life. Projection lamps change automatically in the event of filament failure. Still pictures can be shown.

AUTHOR'S ABSTRACT.

COMMERCIAL EXPERIENCES WITH MAGNA-STRIPESchmidt, E. *Ibid*, 463.

Two years of commercial experience with magnetic striping have shown that successful striping demands film which will remain flat and undistorted under all conditions of climate and use. Some of the distortions to which all sound film is subject are here examined, with particular emphasis on the variations in centreline placement found on variable area sound tracks. Particular problems of magnetic striping are analyzed and a set of standards for stripe placement suggested. Data were obtained from more than 2,000 prints for all uses and categories, including amateur, professional, television and governmental agencies.

AUTHOR'S ABSTRACT.

BOOK REVIEW*Books reviewed may be seen in the Society's Library***THE LOOP FILM.** R. A. N. Smith, *Current Affairs, Ltd.*, pp. 109, 7s. 6d.

The loop film is an important half-way house between the cinematograph film and the film strip, having some of the advantages of both, allied to advantages of its own. It combines the ability to reproduce movement with comparative cheapness of production, and by repeating actions of operations that are difficult of apprehension when seen only once it provides a valuable aid to pedagogy, to training in industry, research, amusement and even the study of films themselves. But the author nearly succeeds in turning away our interest in the subject. He is so convinced of the value of repetition that he adopts it in his writing, even repeating at a few pages distant the same clichés and stories. An example is the speculation about a Chinese proverb which appears as a mere aside on page 27 but is elevated to the status of a chapter heading on page 40. This tends to bore the reader.

The author's somewhat biased interpretation of facts is not always entirely accurate. After stressing that loops were developed by the teaching profession and not by the film trade, which is quite true, he suggests that it was the educational demand for "stills" and reversal mechanism on projectors that caused their introduction, whereas such mechanisms

appeared on some of the earliest of silent projectors before the teachers got hold of them. The author contends that loop films can be made by any amateurs, presumably because they are short. This reviewer has certainly seen some very bad ones made by amateurs, and feels that there is much to be said for introducing professional standards of quality and of accuracy into this work. It is not true to say that the cost of amateur made loops is "the cost of the filmstock." Why will these people so under estimate the value of their own time?

Mention is made of the British Acoustics and Sound-Services films for projector testing, but these can hardly be termed "loop films" in the sense in which they are dealt with in the rest of the book, nor is their purpose analogous.

These blemishes are all the more unfortunate since, if the material in the first 56 "selling" pages were condensed into a more terse and more objective consideration of the uses of the loop film, it would combine with the excellent second part of the volume which is devoted to practical matters, to form an invaluable and inspiring guide to the subject. This second part deals with the making, handling, projection and storing of loop films and is as hard headed and practical as the first part is diffuse and unimpressive.

G. H. SEWELL.

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or

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BRITISH KINEMATOGRAPHY

VOLUME 23 No. 1

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

JULY, 1953

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NEW GRADE OF MEMBERSHIP

Up to the present membership of The British Kinematograph Society has been available only to those gainfully occupied in the cinematograph industry or an allied industry.

This is not to say that, over the years, the work carried out by non-professional people is unworthy of consideration.

Indeed, much is of a high order whether judged from the standpoint of the sincere endeavour of the beginner or, from the studiously applied and progressive worker.

The number of non-professional people actively engaged in some aspect of cinematography has increased considerably during the past few years, and the Society has felt a growing responsibility towards

those who wish to join in the Society's activities and improve their knowledge and technique.

The door is now open for the admission of such people, and, whether they be interested in 35mm. or 16mm. film activities it is believed that by attendance at lectures and courses of study or, through the monthly journal, great benefit will be derived by the new "Associates" themselves as well as by the present members of the Society.

The old Associates of the Society will now be known as "Associate Members" and for both the grades the entrance fee will be one guinea and the annual subscription one-and-a-half guineas.

Forms of application and copies of the modified Bye-Laws are available from the Secretary.

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INFOR

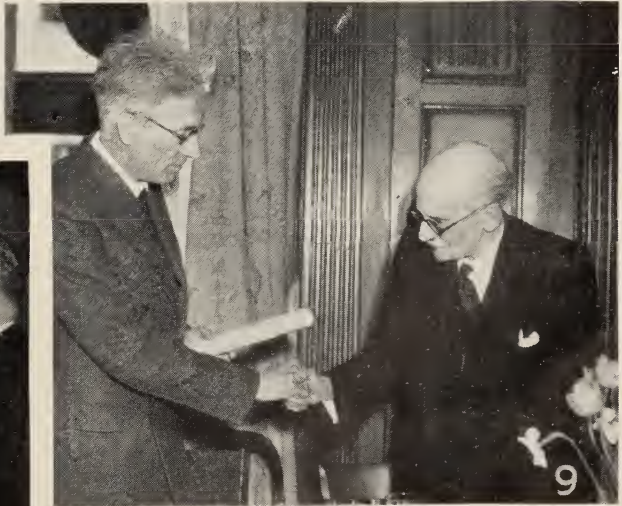
Kettner's F



- (1) Mr. G. W. Pearson
 (2) Mrs. D. Forrester
 (3) Mr. W. S. Bland, Mr. and Mrs. M. S. Bland
 (4) Mrs. and Mr. R. E. Pugh
 (5) Mr. L. Cave-Chinn, Mr. L. Cave-Chinn, Mr. L. Cave-Chinn
 (6) Mr. G. Parr, Mr. G. Parr, Mr. G. Parr
 (7) Miss Joan Poynton and Mr. G. V. Parr

CHEON

May 9, 1953



and M. André Debie.
and Mr. M. Bennison.
Mr. and Mrs. C. Vinten.
and Coun. P. Rigby. (5) Mr. P.
Mrs. L. Cave-Chinn, Mrs. M.
Honri and Mr. G. W. Pearson.
(8) & (9) Dr. Knopp with M.
G. J. Craig, Mr. I. D. Wratten
court.

THE FOURTH CONVENTION

Saturday, May 9, 1953

THE proceedings opened with an Informal Luncheon at Kettner's Restaurant. The event proved popular and some 80 members and their guests saw the President, Dr. L. Knopp, present the Certificates of Hon. Fellowship to M. André Debie and Mr. G. W. Pearson.

Ordinary Meeting of the Society

The programme continued at the Gaumont-British Theatre, Film House, with the Seventh Ordinary Meeting of the Society. A well attended meeting heard the Secretary review the Society's activities during the past year.

These had been greatly extended, and emphasis centred upon the work of the Education Committee. In London, two courses of study had both been over-subscribed and had been repeated in order to accommodate the large number of enrolments. The course on "Television in the Kinema" had been held in Birmingham, Leeds and Liverpool. Altogether, approximately 500 enrolments had been registered in the courses.

The syllabus of training for the Projectionists' Apprenticeship Scheme had been completed and approved. Further, the Society, together with the C.E.A. and the N.A.T.K.E. had been invited to be the signatories to the certificate of competency awarded to trainees at the successful conclusion of their apprenticeship.

The work recently undertaken in respect of the production, distribution and exhibition of 3-D films and wide screen presentation was a task of some magnitude. No doubt the result of the investigation would be anxiously awaited by all sections of the industry.

An important step forward had been taken by the introduction of a new grade of membership. The new member would be known as an Associate of the Society, and the

old Associate would become an Associate-Member. It had, for some time, been appreciated that there existed a number of people, who, although not gainfully employed in the industry, were able to produce evidence that they had made use of cinematographic processes for professional, scientific, educational or artistic purposes. It was from among these, who were either accomplished in the art or technology of cinematography or else seriously desirous of improving their proficiency, that the new Associates would be drawn.

The present membership figures were :

Hon. Fellows, Fellows & Hon. Members	49
Corporate Members	570
Associate-Members	318
Students	36

In the field of standardization much good work had been done. The Society had appointed a Standards Committee to act in a liaison capacity with the British Standards Institution. The President, Dr. Leslie Knopp, had attended the I.S.O. Conference in New York in 1952, as United Kingdom delegate.

Turning to the Sections of the Society, Leeds had made outstanding progress. It was greatly regretted that Mr. N. J. Addison had resigned the secretaryship of the Section due to pressure of work, but the time and energy he had expended would not be lost : the foundations which had been built would prove a solid basis for the future and Mr. A. Buckley could be assured of the best wishes of all in his task as the new Hon. Secretary.

The Hon. Treasurer, Mr. R. E. Pulman, presented the annual accounts.

In his review, Mr. Pulman drew attention to the fact that the income from members subscriptions had fallen below the figure for 1951 but, on the other hand, the income from Patrons donations had increased. There was a surplus of £176 and the total capital of the Society was £924.

Elections

The following had been elected to the Film Production Division Committee :

Messrs. D. C. Dickinson
H. V. King
H. Waxman

Mr. T. W. Howard had been elected, unopposed, as the Divisional representative on the Council.

The following had been elected, unopposed, to the Theatre Division Committee :

Messrs. S. T. Perry
R. A. Rigby
H. C. Stringer

Mr. J. A. Walters had been elected, unopposed, as the Divisional representative on the Council.

The following had been elected, unopposed, to the 16mm. Film Division Committee :

Messrs. J. W. Hissey
W. T. Rudd

Dr. D. Ward was elected, unopposed, as the Divisional representative on the Council.

The following had been elected, unopposed, to the Television Division Committee :

Messrs. G. E. Burgess
A. Challinor
V. M. Gover
H. Harris
T. M. C. Lance
W. T. Rudd
A. C. Snowden
J. A. Walters

Mr. L. C. Jesty was elected unopposed, as the Divisional representative on the Council.

The Officers

Dr. Knopp invested Mr. Baynham Honri with the Insignia of Office. Mr. Honri, the President, announced the Society's Officers and Members of Council as follows :

Vice-President : Mr. H. S. Hind
Hon. Secretary : Mr. R. J. T. Brown
(unopposed)
Hon. Treasurer : Mr. G. J. Craig

Members of Council (unopposed) :

Dr. F. S. Hawkins
Mr. N. Leever
Mr. I. D. Wratten

In conclusion the Past President, Dr. Knopp, presented Fellowship certificates to Messrs. G. S. Moore, C. Vinten and Dr. D. Ward. The Newman Memorial Award went to Mr. N. Leever for his research into and development of cinematographic techniques and mechanics.

Before delivering his Presidential Address (page 8), Mr. Baynham Honri conferred upon Dr. Knopp the Honorary Fellowship of the Society and paid tribute to the invaluable work he had done during his term of office.

The showing of *The Titfield Thunderbolt* brought to a close the day's proceedings.

16mm. FILM EVENINGS

Continuing the policy of screening outstanding 16mm. films, the 16mm. Film Division is holding a further series of Film Evenings during the coming session.

Producers of 16mm. films, who would like their work to be considered for showing on these occasions, are invited to send particulars of the title, subject and length of each film to the Secretary of the Society.

BRITISH STANDARDS INSTITUTION

All B.S.I. departments will remove on August 8, 1953, to British Standards House, 2 Park Street, London, W.1. Telephone: Mayfair 9000.

ROYAL PHOTOGRAPHIC SOCIETY

In order to mark the occasion of the Centenary of The Royal Photographic Society, the Fellowship has been conferred upon J. Coleman, F.I.B.P. (Member), President of the Institute of British Photographers, for his outstanding services to photography, particularly in the field of education and Leslie Knopp, M.B.E., Ph.D., M.Sc. (Hon. Fellow) for his good services and outstanding contributions to the advancement of cinematography.

The Hon. Fellowship has been conferred upon I. D. Wratten (Hon. Fellow) for his outstanding services to the Society and also in recognition of the distinguished contributions he has personally made to progress in photography, particularly in the motion picture field.

THE PRESIDENTIAL ADDRESS

Baynham Honri, F.R.P.S. F.R.S.A. (Fellow)*

Read at the Fourth Convention of The British Kinematograph Society on May 9, 1953.

TRADITIONALLY, the Presidential address of a technical society is a survey of progress made during the previous year, with prophesies of development to come. This survey may cover one particular division of a Society's work, the whole field of its activities or the broader problems of the art or craft concerned.

Past Presidents of The British Kinematograph Society have almost invariably followed this tradition, but the excellent Review of Technical Developments during 1952, published in the February issue of our Journal has forestalled me in dealing with many of the advances which have taken place. Moreover, prophesies of things to come might be taken as prejudging the conclusions to be reached by Committees of this Society upon possible changes of technique in our craft—3-D, wide screen and the like. As to the broader problems, these are debated to such an extent, from their own particular angles, by each of the sectional interests in our industry that the trade papers have to make truncated reports of the spate of oratory. On the other hand, the mission of this society is to promote the exchange of knowledge for the technical improvement of all branches of our industry. But we must remember that our efforts are largely—though not wholly—devoted to an entertainment medium of storytelling, and our policies must be guided to a large extent by the directors, producers and writers who make the films and the exhibitors, the retailers, who present them to the public.

A suggestion was made recently that the exhibitor interests should be barred from the important Cinematograph Films Council. In other words, that the retail interests in the sale of consumer goods should be deprived of a voice in the industry's joint councils. Such a suggestion is, of course, absurd. I feel that the Cinematograph Films Council

should have the widest possible representation within the industry, and for this reason put forward the counter suggestion that it should be expanded to include a representative of The British Kinematograph Society. There are many precedents for non-political craftsmen having an opportunity of expressing their views. The Railway Gauge Commission, convened by the Board of Trade in 1846, included representatives of learned bodies in addition to various interested parties. Their recommendation was a standard gauge of 4ft. 8½ins. to supersede the multiplicity of tracks from 2 feet to 7 feet which threatened to retard the interchange of traffic—just as the multiplicity of 3-D and panoramic standards seems to threaten us now. This Society is setting up a number of Committees to examine dispassionately all aspects of this problem, and it is hoped to plant technological seeds which, with good-will from all trade interests, will yield a harvest for the benefit of all—including the customers who pay the money at the box office.

As you know, I am concerned with the production side and I feel sure you would not wish me to add one more dismal summing-up of the almost insoluble problems which confront British Studios. The P.E.P. Report on the British Film Industry¹ and many other excellent surveys have set out the financial and economic problems clearly and plainly. On the other hand, our purpose here is to maintain technical progress and to spread knowledge of new techniques of production and presentation of films. This is also the main objective of the very active Film Production Division of this Society. The Film Production Division has a fairly large membership, yet it is a matter of regret that even more studio technicians do not apply to become members. Film production personnel are hard-working folk and every day's shooting has its special problems. It is

* Ealing Studios Ltd.

regrettable but not surprising, that they tend to develop an apathy as regards things which happen outside their own particular studios or in other sections of the trade. In these vital days of rapid technical advancement, I look forward to a considerable increase in the membership, not only of the Film Production Division, but of the Society as a whole.

I would now like to turn from the general to the particular and refer to a few recent problems, especially those concerned with film production, some of which were reported in the Review of Technical Developments already mentioned.

Colour

First, referring to colour, the review draws attention to the complex situation in this country in regard to the release printing of negatives made in America on integral tripack systems. Due to the dollar position, negatives shot on, for instance, Ansco or Eastman Colour, have been printed on Technicolor, Gevacolor and Ferraniacolor. This flexibility is likely to increase with the mixing of different types of negative material in the same subject, for instance, if a specially fast stock is used for night or underwater photography. The colour laboratories seem to be quite willing to make special arrangements to cope with such differences in negative material, which, under certain conditions, will give the lighting cameraman more freedom to achieve the effects he wants.

Technicolor is now producing a three-strip negative which is balanced for interior lighting at a colour temperature of 3350° K (with tolerance down to 3200° K and up to 3400° K) as against the old H.I. arc light rating of 5400° K.² This enables excellent results to be obtained with incandescent illumination at key lighting intensities as low as about 150 ft. candles compared with 600 to 1000 ft. candles formerly required. Nevertheless, special C.P. tungsten bulbs are required, since the standard M.P. tungsten bulbs for black-and-white photography, give a colour temperature of 3000° to 3200° K only. The running costs of C.P. bulbs are

high—three or four times as much as M.P. bulbs—due largely to their short life. If these emulsions or the processing could be adjusted so that a very slightly lower colour temperature could be accepted, around 3200° K, then a tungsten bulb of relatively long life and low cost could be used for both colour and black-and-white photography. Experiments are taking place and if successful will greatly reduce the cost of making films in colour. Several integral tripack systems are already balanced for the lower colour temperature. Indirectly, such developments will enable the mobile studio system, used up to now for black-and-white photography, to use colour.

Turning to 35mm. camera equipment, the Coronation has provided the incentive to accelerate the development of long focus and zoom lenses, in which British firms are well to the forefront. These lenses are primarily of interest to newsreel and television, but will no doubt be taken up by feature film producers in due course. For special production work in difficult locations, such as in wildest Africa or on the snowy heights of the Alps, the zoom lens will overcome many physical problems. We also watch with interest the progress of the electronic camera, which is readily adaptable for photographing pictures for anamorphic wide screen projectors.

It is strange that at this stage in the development of our techniques, camera motor-drives should require reconsideration. The fact is, there are few D.C. camera motors to fit in blimps which can be made to operate consistently at or very near to 24 frames per second. For instance, notice how the speed of troops marching on newsreels varies from shot to shot, with troops getting in and out of step with the music. This is due to speeds varying from 22 to 26 frames per second with different cameras as a result of insufficiently accurate tachometers and under-powered motors. When sound is being recorded with a synchropulse or similar system, picture camera motor speed affects the pitch of the sound when transferred from tape to photographic 35mm. track. It

is therefore important that the D.C. camera motor problem be tackled with the object of achieving a more accurate speed, automatically controlled, and yet without unduly adding to the weight of the equipment.

Stereoscopic Wide Screen Presentation

I do not propose to refer in detail to the many stereoscopic and panoramic systems now being presented to the public in America and starting to come over here. All I will say is that I am sure that British equipment manufacturers are fully aware of possible demands and will be able to cope with any special camera, projection or screen requirements, when the standards are agreed. This is a matter which is *sub judice*.

Magnetic Recording

Magnetic recording on 35mm. film and on $\frac{1}{4}$ -inch tape is becoming more widely used in British and American Studios.³ The use of a magnetic recorder in the re-recording process can effect a saving in film stock and processing of upwards of £400 on a single production. Furthermore, the composite re-recorded magnetic track can be used as a master for transferring to any number of photographic negatives—for instance, a sound negative for America, in addition to separate negatives for Australia and the home market. The magnetic track can also be used for re-recording sound on to 16mm. sound negative for contact printing, giving a much improved 16mm. sound print quality unobtainable by optical reduction or by re-recording from a 35mm. photographic release print. For foreign versions, studios have to supply "M. & E." (music and effects) tracks, without dialogue, to be used by the dubbing studios abroad to mix with a dialogue track made in the foreign language. At present, the making of an "M. & E." track necessitates a separate re-recording operation, but the development of a multiple track recorder, with three tracks on one magnetic film, provides a separate dialogue, music and effects track from which any combination of the three can be derived with the comparative simplicity of a printing operation. While the

equipment now available for three magnetic tracks, each of 200 mil width, a further development may increase this number to four tracks. Such recorders will also be a necessity for stereophonic recordings.

Mobile Studio Unit

The most expensive item in film production is time, and the fickle English weather being the greatest time waster, means have to be found to overcome the long waits for the sun on location. The mobile studio unit system enables shooting to continue on small interior sets in improvised studios when the weather is bad, thereby saving both the time and the morale of a location unit.⁴ The broader canvas of film production, partly resulting from competition with television, has focussed attention upon all techniques which remove the risk of lengthy location schedules. Booster light on location, now the rule rather than the exception, helps a great deal, but no single-point light source can at present compete with the bright but very flat light of a dull English Summer's day.

A super lamp, two or three times as bright as the fine "Brute" lamp, would give a good sunlight effect under these cloudy summer conditions,⁵ but it would have to be used from a height to achieve a really good effect. One visualises such a lamp being mounted on a high telescoping tower, capable of being carried about on its own power truck yet easily dismountable for manoeuvring in awkward places. The cost of such a lighting unit would no doubt be very great—but what an insurance against dull weather it would be on a spectacular crowd location! Such a mammoth lamp has not yet been produced—but some preliminary experimental work has already been carried out.

Use of Reflectors

The design of reflectors for exterior use has not changed since the silent days. When *Where No Vultures Fly* was being made by Ealing Studios in Africa, the standard ply-type reflectors suffered from warping and caused many difficulties. It was therefore decided to evolve a warp-proof reflector

before another African location picture was attempted. After some experiments a circular plastic reflector was evolved, lightly held at the edges, and with a central control knob to keep it flat or make it concave or convex. The plastic material was covered with silver paper on both sides, one side being matted. By regulating the knob, the warp of the reflector could be controlled and made to spread or spot the reflection. This type of reflector has been highly successful and has proved a great time saver.

Another device which is now being used in the studios is the hydraulic ramp, enabling relatively easy control of rocking platforms to be achieved.

Location Problems

This evening you will be seeing *The Titfield Thunderbolt* and it may be of interest to you to hear of some of the special technical facilities which were used on the location. British Railways put a single track branch line at the disposal of the film unit, together with rolling stock and two tank engines. In addition, they overhauled and put into steam the 115 years old Liverpool and Manchester engine "The Lion," loaned by the Liverpool Engineering Society. A 300 ampere diesel-electric generator was mounted in one of the trucks for booster light and an additional 1500 ampere generator on a lorry was also available.

Radio Telephony under licence from the Postmaster General was used for train control and also for communication with the location unit office.⁶ This facility was, by the way, of major importance during the location work on *The Cruel Sea* and *West of Zanzibar*, especially in the ship to ship and ship to shore communication in the former.

The viewing of rushes on location was catered for by the provision of a temporary theatre in an old mill, where a projector was installed having an H.I. arc. This derived its current from a generator driven by an ancient water turbine, surely the first time a motion picture has been illuminated by means of power from a water wheel! Colour

pilots could be accurately assessed with this light—a great improvement upon the light of the usual portable projector.

Special Processes

Trick processes were used for a large number of shots which it was not possible to obtain inside the vehicles and on the foot-plates, Technicolor travelling matte being extensively used. The foreground shots filmed in the studios were photographed in front of a blue backing and the blue record of the 3-strip process made an ideal matte through which was superimposed the moving background.

Travelling matte,⁷ both in colour and black-and-white, has reached a stage of perfection in this country when it can be used by film directors with confidence and without placing undue mechanical restrictions upon their choice of camera set-ups.

These are just a few of the aids to production which are of especial use to film making in a country where the weather is so unpredictable. Locations used to mean extended schedules and high costs. The ingenuity of technicians has been devoted to finding ways and means of tackling locations painlessly, thus broadening the scope of production and, amongst other things, enabling film directors to develop a style which cannot be imitated by Television.

Role of the Society

We are fully aware of revolutionary changes in technique which face us during the next two years. In the long run, it will be the public themselves who decide whether they want stereoscopy or flat films, wide screen or large screen, stereophonic or "flat" sound. The British Kinematograph Society, together with the Society of Motion Picture and Television Engineers can fill an important role in bringing together the competing interests, with the object of achieving early standardization by evolution rather than revolution. Intermediate standards of screen aspect ratio may soften the blow of heavy capital expenditure.

I am sure that the various Committees of the Society will see that all members have the opportunity of hearing first-hand information on all these new developments. This is no time for apathy : I look forward to a rapid growth in our membership which, in itself, will be a sign to the rest of the film industry that this Society is playing a

major part in ensuring the continued progress of the British film.

Acknowledgements

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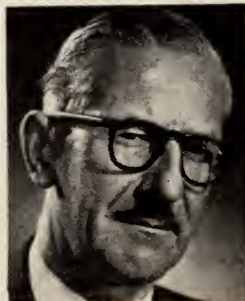
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THE USE OF FILM IN TELEVISION PRODUCTION

Ian Atkins*

Read to a meeting of the Television Division on January 28, 1953

FILM may be used in relation to television in many different ways. Let us consider and discuss the different techniques of film and television and the different demands on the units involved.

The Complete Film

The main differences between the cinema and television lies in the audience for which each is intended. The television audience of three people at home is very different from the cinema audience of three hundred or more similar people out for the evening ; it is a more difficult audience than that with which the film director or stage producer has to contend.

When a person decides to go to the theatre or cinema, he wants to "have an evening out" in company with several hundred other people and he intends to enjoy himself. In fact he is prepared to go half-way to meet the people on the screen or the stage who have set out to entertain him.

The television audience is less easily moved to loud laughter and far more easily embarrassed and shocked at home than in the cinema. Self-consciousness in front of one's family, and without the example and support of several hundred others, is the basis of this difference which must be allowed for in making television programmes. Comedy style must be suitably modified and emotional scenes carefully watched against over-emphasis. Above all, a guard must be taken against a very natural tendency to trade on the undoubted fact that the television audience has very quick perception, which is shown in their reaction to comedy. An audience can be greatly amused without bursting into audible laughter and, because this laughter is not momentarily reducing concentration it will take the point of a joke much more quickly than would be expected. It will see an unskilfully prepared joke a mile away and

at its intended climax will be impatiently waiting for the next. Comedy on television must be played so much faster than on the stage that it is often difficult to persuade established actors to keep up what is to them such an unprecedented pace. To engage an actor to play a comedy part in television which he has already played in the theatre is most dangerous.

This quick perception of the television audience does not excuse bad story-telling. Points of plot and character will be grasped with surprising ease if they are made clearly and in correct order and context. It is in the production of thrillers and detective stories that, next to comedy, the greatest problem is presented. If one tries to give the viewer all the clues available to the "Great Detective" one can easily explode the mystery far too soon by being slightly over-emphatic or self-conscious about some minor piece of evidence. The television audience spots it quickly and the "magnificent brain" is reduced to clottish stupidity by being some 30 minutes late in getting his man.

The purely technical problems of television films are diminishing. The small screen is gradually growing larger and the rules of to-day will be out-moded by to-morrow. To-day the medium shot is the most difficult to use. A long shot has its own pictorial composition and action to sustain it and make it interesting. The close-up reveals thought and motive clearly and dramatically as does to a lesser degree the medium close-up. But the medium shot can easily be too far away to show interesting detail while providing no compensation in composition or action. To put the problem of television pictures, "Watch the mid-shots, and the rest will take care of themselves." The quality of the negative and print for films in this category need give no worry. The Central Telecine Room, which would transmit such a pro-

* British Broadcasting Corporation

gramme can handle a normal show copy such as would be made for any good cinema.

The Introductory Film Sequence

This category is virtually self explanatory. It may consist entirely of stock shots showing, for example, the Statue of Liberty, the New York skyline, Broadway traffic etc., with main titles superimposed by a studio camera and final shot linking suitably with the first studio picture. Alternatively a member of the cast may appear in the film and lead the way into the story.

It will be appreciated that in general this technique is only applicable to a firmly realistic style of production and that stock shots must be chosen with great caution.

No great technical difficulties need be encountered with this type of sequence. Quality matching is not hard, since a change of scene usually coincides with the change from film to studio. One danger in the use of stock material is that shots are liable to be very short and to set up a cutting tempo which will not be maintained in the studio. There is nothing against a fast cutting sequence and the idea that a television audience cannot grasp such a sequence on the small screen is a fallacy if the pictures are clear and if the mid-shot has been used with discretion. Unless, however, a very definite change of mood accompanies the inevitable slowing down of cutting tempo at the point where studio action starts and the film ends, the audience will feel instinctively that something is wrong.

The Complete Story Sequence

Here a precise correspondence in technique is usually required. A subjective "dream sequence" or remote flash-back may present the opportunity for a divergency of style, but in general the characteristics of studio television story-telling will be needed to preserve continuity.

How can these characteristics be defined? In television production the dialogue is much fuller than would be used to carry the equivalent story content in a film, but less full than is needed in the live theatre.

A high proportion of theatre plays must obviously be shown to the television audience for two very good reasons. First, it is right and proper that the classics of the English and foreign stage should be produced in the form in which they were written, for it was in this form that they earned their right to be included among the world's classics. Only an author of stature equal to that of the original playwright should presume to alter them to any significant extent. Second, the material needed to meet a present commitment of about one hundred productions a year cannot be all original. Some other than classics must be shown.

The process of adapting these for the television screen provides some interesting lessons. Most plays are improved by skilful cutting. Not only is repetitive dialogue glaringly evident but reiteration of situation or of mood becomes irritating. The traditionally accepted mechanical devices of the playwright in engineering his action into one or into a small number of sets seem clumsy and obvious and the slightest suggestion of "padding" is glaringly apparent. This second category of stage plays tends, therefore, seldom to remain in the one set of the theatre when it appears on the television screen. The playwright's necessary but apparent mechanics are eliminated, better opportunities for cutting and pruning are provided and a smoother, tauter production results. It was at one time thought that television producers were spreading themselves into a multiplicity of sets regardless of the additional and unnecessary design costs thereby incurred. Seeking to justify these costs they overworked the device on the grounds that, if the additional set was seen five times instead of twice its construction would seem worth while. Since the three additional scenes were not merely unnecessary but frequently quite wrong the position became tense and a return to the stage settings complete with "Mrs. Jones' Sitting Room. Three Days Later. Morning," type of caption was the order of the day. This setback was short-lived because the creation of a Script Department introduced a new and unbiased body of opinion in script-adaptors. They had no directional axe to grind, but

they soon concluded that a judicious increase in the number of sets was often the key to a better television version of a stage play. Television, then, needs less dialogue than theatre, but more than film. Hence television needs shots of longer average duration than film or (since cameras are relatively cumbersome devices and change of angle is not a quick process) a repetition of the same shots at shorter intervals.

How should these individual shots fit together? What is the grammar of television? A brief comparison between television and film may lead to a conclusion for, though different in purpose and in form, the two media have similarities which are more than merely apparent. Both can cover a wide field from epic drama to the lesson in school and both do it by means of moving pictures with accompanying sound. These pictures are directly comparable and in this context their possibilities and limitations are virtually identical. Order and clarity of exposition must come first and other attributes can only be admitted when these two are achieved. It may be said that television has special properties which must in time create their own style and method, but this does not invalidate the argument that the far larger proportion of shared properties demand a common usage.

Television then should use the grammar of the film. Established rules of cutting, movement, dissolve and fade apply. Any differences should be those of style rather than of grammar and will be due to the way in which the actor's performance is presented on the screen. The fact that the performance is continuous and that time in its inflexibility and indivisibility is an enemy rather than a friend to the television director is the most obvious and the most formidable problem of television. For this reason space also becomes possessed of devilish attributes calculated to frustrate the television director. On film to dissolve from the leading man in plus-fours on the golf course to the leading man in a dinner jacket in the night club, or to cut together successively shots of two people taken from the same camera position are matters so commonplace as to be beneath

consideration. In television both are impossibilities. Further, you cannot dissolve from the leading man in one set to the leading man in another set even if he does wear the same suit of clothes. Nor can you cut from one shot to a reverse showing the previous camera position. Now these facts lead to a style of presentation which should be followed if we are to marry a filmed sequence skilfully and unobtrusively into a studio production. Completely reversed shots are rare in television because the number of cameras and hence the number of simultaneous camera positions available is limited. That is to say the side angle which leads to and from the reverse shot can seldom be provided. The fourth wall is rarely seen. When it is seen, the betting is that the first or third wall will be invisible for that particular sequence. Many similar considerations are instantly apparent if the problem of shooting a scene from start to finish in its actual playing time is considered. The method dictated by the hard facts of television production produces in viewers a subconscious expectation and habit. If the unexpected occurs at a moment when a dramatic shock is desired all well and good. If there is at the moment in question, however, no dramatic point to make, the unexpected merely causes a momentary withdrawal of concentration and a quite unexplained and indefinable feeling that all is not well. The film calculated jump-cut to make a story point is good. A cut which jumps for no dramatic reason is bad. Summarizing then, in making film sequences for television one must so place the camera and restrict camera angles as to conform with a possible live camera lay-out. This is by no means as hamstringing as it sounds and a little ingenuity will usually produce a satisfactory plan. It is advisable to avoid the apparent presence of a character in two places at once even in a dissolve and to allow the character to clear one picture before entering another. This is a problem to be sorted out when the shooting script is planned and affords little hardship if recognised in advance, preferably in the scripting stage. One further point with regard to the complete film sequence: on the small screen it is advisable to introduce new charac-

ters in close-up whenever possible or to show them in close-up very soon after their first appearance. Dramatically this would seem to be wrong, but where that first close-up is saved until the correct dramatic moment, the viewers reaction is more likely to be, "so that's what he (or she) looks like," than the appropriate response to an important moment in the story. Introduce a new character, then, with a brief close-up.

The picture quality of such a sequence must obviously match the rest of the show, but, unless it takes place in a set which is also to be shown in a live sequence a fair amount of latitude is permissible.

The Bridging Sequence

The most difficult problem with this type of sequence lies in the initial decision as to whether to use it or not. A bridge is by nature likely to be short in comparison with the sequences which precede and follow it. For this reason it can easily cut up the continuity of the story in an unsatisfactory way. If at the scripting stage a bridge does not appear essential it is probably better to do without it.

Where it is unavoidable, ideally the shape of the script should prepare the way by providing one or two shortish scenes just before the bridge sequence and if possible immediately after. It is not always possible to write a story in this way, but, where it is possible, the result is smoother and more integrated and the bridge will lose its artificiality and merge into the narrative construction. Where this method of scripting is inapplicable it is often better to lengthen the bridging sequence so that it becomes a story sequence in its own right.

Technically the problem is similar to the sum of the problems presented by the opening and closing film sequences. Style and cutting tempo and so on must not present a marked contrast to the studio scenes. The film sequence should, as it were, "wind up" and "wind down" again where, as is frequently the case, the main effect is to be made by means of a "montage," using the word in the colloquial sense defined by Ernest Lindgren as, "an impressionistic assembly

of short shots designed to bridge a lapse of film narrative by briefly indicating the passage of events within it."

The Composite Film and Studio Sequence

This is the most acute problem of matching. To achieve success, style, action, continuity, camera angles and, above all, picture quality must exactly correspond. The action must be worked out to provide good cutting points for the changes from film to studio and vice versa and, since we are depending on a chain of human reactions to cue each change over, it is desirable to select these cutting points very carefully so that the greatest possible overlap is obtained and hence the greatest flexibility in the actual cut. Allowance must also be made for the running up to speed of the film machine (Telecine Apparatus) or, where the film must run continuously, though unseen, during a cut to the studio, the studio action must be drilled to an invariable length so that the cut back to film is always correctly timed. This all sounds very formidable and it is true to say that the haphazard shooting of film can make this type of sequence a nightmare for all concerned. If carefully visualized and planned in advance, however, it can be completely successful and easy to handle in transmission.

Since film and live shots must be indistinguishable on the television screen, studio lighting must match film lighting and film must be shot with this in view. Frequently perfect film lighting which cannot be matched in the studio, must be abandoned in favour of a less good arrangement which can be exactly reproduced. Each television system has its own characteristics corresponding with the speed, contrast range, colour response, gamma and so on of a film emulsion. In the studio, lighting and tonal values of set, costumes and make-up will be arranged to produce a picture of the quality desired. It is clear that if our matching film is to be shown on such a system, the print must be of the same character as the studio scene. Where, for example, the television system can only handle a relatively restricted contrast range, a flatter-than-normal print must be provided. Special processing will be needed and the

original negative must be where possible controlled. In the case cited harsh light effects would be avoided, shadows would be filled by means of reflectors on exteriors and everything would be done to provide the "soft" negative required. Where the film transmitting system is unlike the associated studio camera system it is even more difficult to control the quality of the film print so as to produce indistinguishable pictures.

The Insert

Here all the considerations of matching previously discussed are applicable as are the problems of continuity in an even more acute form. The reading of a letter or showing of any other typical insert can be much more effective and less of a jar if the cuts are on a movement rather than to and from a static frame. It is often easier for the actor involved in the studio to cue himself from a picture monitor than to take signals. It is advantageous to shoot the insert where possible after the scene in question has been rehearsed for a few days and the most effective relevant action has been evolved.

Film Background

Back projection provides the most obvious example of this requirement. While television is fast evolving continuous methods of using still plate back projection peculiar to its own needs and very different from the methods of the film maker, in moving back projection the requirements are at present similar and are likely to remain so for many reasons. Naturally the type and density of print required will depend on the television system in use, but essentially the processes are identical and the problems presented similar, though for television they are more formidable because of the continuous action involved.

Recently the Designs Department of the B.B.C. has evolved and demonstrated most effectively an apparatus which performs three operations. One of these produces the effect known to film makers as the "wipe" and need not concern us here. The other two, known respectively as "Inlay"¹ and "Overlay" may in due course affect profoundly the use of film in television.

Both processes are means of combining in one composite picture pre-determined areas of the pictures from two separate channels. Either or, on occasions, both of these individual pictures may originate from film.

Inlay enables a fixed area of one picture to be obliterated and replaced by the corresponding area of another picture. For example, in its simplest application, a house built in the studio could cover three-quarters of the picture while, seen beyond it in the fourth quarter of the picture could be a filmed and "inlaid" street. Or a street scene could be filmed while inlaid in the first floor of one of the buildings could be a window built in the studio through which one of the characters in the play could be looking. Of course in the first example no one could walk past the end of the studio house and in the second example no bus on film could pass in front of the studio window. In short, Inlay is the television equivalent of the film "split screen" technique with similar advantages and restrictions. Its great advantage as a television tool, however, may prove to be that it can be used or abandoned instantaneously and at will. For example a scene may be laid in an army hut on the edge of the barrack square. For the majority of the time we may see through the window a still back projection plate or even a photographic backing, but at appropriate intervals we may inlay a filmed window through which is seen a squad of marching soldiers. During this time it is true the studio actors must keep clear of the window frame, but the flick of a switch restores the scene as it was before and complete freedom of movement is possible in the studio set. Time and experience will undoubtedly produce hundreds of ingenious ways of using the Inlay process. Not all of them will use film, but it is safe to say that film will play a very important part in the utilisation of the process.

"Overlay" is analogous to the travelling matte process of the film studio. Characters in the story stand in front of a black or white background according to the television system in use and they appear against a background provided by a second picture channel, which may well be a film channel. If the foreground

characters are not to "ghost" with background seen through their bodies, the background must be suppressed over the area which they cover. In this process the foreground characters provide their own "electronic matte," and for this reason care has to be taken to control the tonal values of the foreground characters or objects. Where a black background is used on the foreground channel, no substantial area of the foreground characters must be equally black, as this tonal separation is used to provide the signal which obliterates the background picture when not required. Similarly, where so-called "white obliteration" is used, no substantial area of the foreground must be as light as the white background. Only experi-

ence can show how restricting these considerations will prove to be. In the demonstration of white obliteration already given the model wore a light yellow jumper and even a piece of white paper waved in front of the camera did not easily cause the process to fail.

I hope that the foregoing will have shown that, although considerable progress has been made, great opportunities still lie ahead in the use of film as a contributory factor in the building of television programmes. The scope of the writer and producer can be widened enormously by the skilful introduction of film into live action and the immediacy of the television screen, paradoxically can be thereby enhanced.

BOOK REVIEW

Books reviewed may be seen in the Society's Library

THE TECHNIQUE OF FILM EDITING. *Compiled by Karel Reisz for the British Film Academy. Focal Press, Ltd., pp. 288, 30s.*

Though a large number of books has been published on nearly all aspects of filmcraft, those on editing have, since Pudovkin's "Film Technique," been at best very superficial in their approach.

The reason for this may well be that the art of editing is very complex and one that by its lack of rules and generalisations makes a theoretical approach extremely difficult and unsatisfactory as regards both criticism and analysis.

However, Mr. Karel Reisz has bravely stepped in where others have feared to tread and the result is a compilation which is as easily readable as it is instructive. For, not only has Mr. Reisz wisely solicited the aid of several of this country's leading Film Editors, whose comments alone are worth considerable attention, but he has himself assimilated and digested the essence of its technique. For instance, his analysis of a number of sequences from varying types of films shows both technical perception and an obvious affection for the job. Mr. Reisz has also avoided the trap of confining his analyses to the classic silent films and is aware of the importance of sound as an aid, rather than a hindrance to the editor.

There can be few editors, either in this country or in America, who have the time or opportunity for experimental work in their own field. The average editor's job is to translate the dramatic content of the component shots of a sequence and assemble them in a form which will give full point to the director's

intentions, show the stars (in the average commercial film) to the best advantage and at the same time produce a smooth and professional result.

Mr. Reisz is well aware of this and it is his catholic approach and understanding of the whole complex work of the cutting room staff that should make this book appeal to the professional film maker as well as the student for whom it is intended primarily. The book is divided into three distinct sections: The History of Editing, The Practice of Editing and The Principles of Editing which, together with notes on Cutting Room Procedure, a glossary of terms and a number of illustrations of the sequences analysed, form a sound and logical basis of the theory of film editing.

Although it would seem invidious to make rather petty criticisms of such an altogether excellent and unpretentious textbook, the author has a tendency to make somewhat sweeping generalisations and rules which editors themselves would undoubtedly wish to break. The weakest sections of the book are those devoted to the Sound Track, where Mr. Reisz becomes almost dogmatic, and Cutting Room Procedure which is neither as full nor as accurate as it might be, i.e. no mention of silent turnover, the assertion that post-synching takes place after the picture has been finally cut, etc.: but these are mere quibbles, for, in spite of its somewhat high price, the book is, as the dust jacket claims "a unique survey of the central creative problem of film making and as such will prove indispensable to professionals and amateurs, connoisseurs and students alike."

PETER TANNER.

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TECHNICAL ABSTRACTS

MANUFACTURE OF MAGNETIC RECORDING MATERIALS

Schmidt, E., and Franck, E. W. *J. Soc. Mot. Pic. & Tel. Eng.*, 60, 453, 1953.

This paper describes in a general way the basic techniques employed in the manufacture of magnetic recording materials. Quarter-inch tape is first discussed, then full-width magnetic tape and striping. Last is a brief prognostication of coming trends.

AUTHORS' ABSTRACT.

MAGNETIC STRIPING TECHNIQUES AND CHARACTERISTICS

Kaspin, B. L., Roberts, A., Jun., Robbins, H., and Powers, R. L. *Ibid.*, 470.

This paper describes the progress made at the Bell & Howell Co., since 1947 in the development of a magnetic sound track for motion picture film : methods of sound track application ; compositions tested ; testing procedures ; chemical, mechanical, and electrical results obtained ; and standards adopted.

AUTHORS' ABSTRACT.

MAGNETIC STRIPING OF PHOTOGRAPHIC FILM BY THE LAMINATING PROCESS

Persoon, A. H. *Ibid.*, 485.

This paper describes a new method of magnetic striping of photographic film using a combination laminating and transfer process. The stripe is transferred from a temporary backing to a photographic film by using heat and pressure to laminate a magnetic tape, face side down, on the film, and removing the backing. The magnetic stripe which remains adhered to the film is very uniform and smooth. This method of striping has the advantages of requiring a minimum amount of space, ease of operation, no solvent hazards, and the uniformity of the stripe can be more easily controlled.

AUTHOR'S ABSTRACT.

MAGNETIC SOUND TRACKS FOR PROCESSED 16mm. MOTION PICTURE FILM

Dedell, T. R. *Ibid.*, 491.

The procedure developed at Eastman Kodak Co. for applying magnetic sound tracks to processed 16mm. motion picture film is fully described. Complete details are given for the coating composition, the dispersing technique and the method of coating. The bead coating method is used. Problems related to coating on film are discussed. Sound-quality measurements are reported comparing these coatings with commercial quarter-inch tape.

AUTHOR'S ABSTRACT.

NOTES ON WEAR OF MAGNETIC HEADS

del Valle, G. A., and Ferber, L. W. *Ibid.*, 501.

Since physical pressure (under contact) is essential between a magnetic head and magnetic media to provide high-quality sound, it is of extreme importance to determine the operating life of the head. This paper describes the methods used and the results obtained in establishing the wearability of the record-reproduce heads on RCA magnetic projectors.

AUTHORS' ABSTRACT.

A STUDY OF DROPOUTS IN MAGNETIC FILM

Franck, E. W. *Ibid.*, 507.

Recording and playback losses caused by coating imperfections are evaluated quantitatively. A new technique is described, called "Micropolishing," which physically removes the mound or "nodule" type of imperfection.

AUTHOR'S ABSTRACT.

METHODS OF MEASURING SURFACE INDUCTION OF MAGNETIC TAPE

Bick, J. D. *Ibid.*, 516.

Of various indirect methods of determining surface induction, two are the subject of this discussion. Called the short-gap and the long-gap methods, they can be employed with any suitable magnetic recorder in the field.

AUTHOR'S ABSTRACT.

STANDARDIZATION NEEDS FOR 16mm. MAGNETIC SOUND

D'Arcy, E. W. *Ibid.*, 526.

Industry requirements for 16mm. magnetic sound standards are outlined with respect to universal reproducibility, and test film needs for equipment manufacture and maintenance are described.

AUTHOR'S ABSTRACT.

Part II of the April, 1953, issue of the *Journal of the Society of Motion Picture and Television Engineers*, containing the symposium on magnetic striping of film, is available for loan from the Society's Library.

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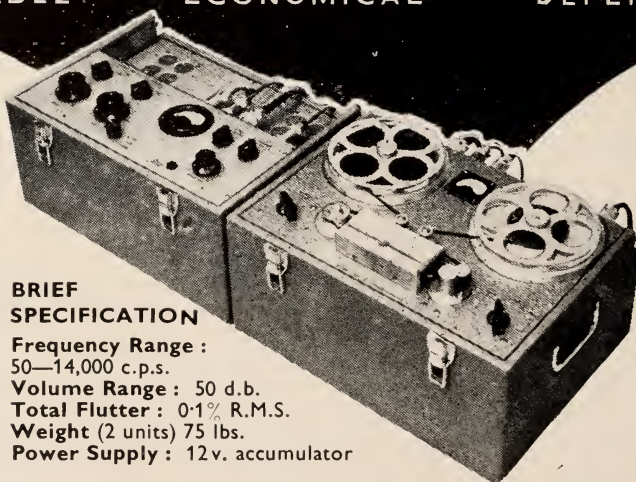
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BRITISH KINEMATOGRAPHY

VOLUME 23 No. 2

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

AUGUST, 1953

CONTENTS

[illegible]

STANDARDIZATION OF COLOUR PROCESSES

SPEAKING at the Society's Dinner last April, Dr. Leslie Knopp referred to the importance of standardization in the processing of integral tri-pack colour materials, and stated that the Society would be preparing a basic standard of colour sensitometry, hoping thereby to provide a fulcrum by which the interests of the sensitized materials manufacturers on the one hand could be balanced by those of the processing laboratory on the other.

It is of interest to note that one of the papers to be presented at the R.P.S. Centenary Conference will deal with this problem. Dr. Luyten of Gevaert

Photoproducten, N.V. Antwerp, will make suggestions for the interchangeability of negative and positive commercial colour materials. These suggestions will doubtless be most useful to the Society in the preparation of the basic standard. It has recently been announced that the release prints of films produced on integral tri-pack negatives can now be produced by the Technicolor process.

It would appear that the Society, by bringing together all interested parties, could, by its investigations, effect a great saving in the production of films in colour.

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LECTURE PROGRAMME — AUTUMN 1953

The meetings will take place at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1. The evening meetings will commence at 7.15 p.m., and the Sunday meetings at 11 a.m.

SOCIETY MEETINGS

- October 7 ... "Considerations of Wide Screen and Stereo-Cinematography," by R. J. SPOTTISWOODE, M.A. (Member).
- November 4 ... "Factors Affecting 16mm. Picture Illumination and Quality," by D. S. MORFEY.
- December 2 ... "A Comparison of Acting for Stage and Cinema," by BERNARD MILES, C.B.E. (Joint Meeting with the British Film Academy).

16mm. FILM DIVISION

- October 14 ... "The Production of Film Strips in Colour with Sound," by H. PURCELL, M.A.
- October 27 ... 16mm. Film Evening.
- November 24 ... 16mm. Film Evening.
- December 9 ... "The Duplicating of 16mm. Colour Films," by R. G. F. CHASE and I. B. M. LOMAS A.R.P.S. (Member).

THEATRE DIVISION

- October 4 ... "The Practical Problems of 3-D Presentation": a discussion meeting opened by G. E. FIELDING.
- November 15 ... "Practical Problems in the Projection Room." JOHN PARSONS will open another discussion meeting.

FILM PRODUCTION DIVISION

- October 21 ... "Production Aspects of Stereoscopic, Cycloramic and Other Wide-Screen Systems," a symposium including :—
 "3-D Production Methods," by R. J. SPOTTISWOODE, M.A. (Member).
 "Wide Screen Production Methods," by F. A. YOUNG, B.S.C. (Fellow).
- November 18 ... "Stereophonic Sound Systems," by A. W. WATKINS, A.M.I.E.E., F.R.P.S., F.R.S.A. (Hon. Fellow).
- December 16 ... "Standardized Light Sources for Colour Photography," by R. L. HOULT, A.R.P.S. (Member).

TELEVISION DIVISION

- October 28 ... "The Impact of the Coronation on the B.B.C. Television Film Unit," by P. H. DORTÉ, O.B.E. (Member).
- November 25 ... "Medium Screen Television," by H. IBBOTSON, B.Sc.

PROCESS PROJECTION IN COLOUR

*A Symposium presented to a meeting of the Film Production Division on
February 25, 1953*

I—INTRODUCTION AND PHYSICAL ASPECTS

R. L. Hoult, A.R.P.S. (Member) *

PROCESS projection, or back projection, is now an accepted technique in all major film production studios. It is not proposed to describe in detail the nature of process projection but to consider some of its especial requirements for the production of films in colour.

Fundamentally, the technique is the same whether the film used be colour or black-and-white. The film used in the process projector may thus be a coloured print which is projected on to a translucent screen. The picture so obtained may be rephotographed with a camera also containing colour film to form, with the addition of artistes and set, a composite scene in colour.

It has yet to be shown whether it is possible to obtain in the composite scene the same quality of reproduction as would have been obtained by any practicable alternative method. It is a recognised fact that when a film is made in colour the audience is more critical of its technical quality than it would be had the film been black-and-white. It seems as though the more realistic the picture becomes, the more is realism demanded and the smaller the tolerances allowed the technician.

To illustrate this point, consider the film *The Tales of Hoffmann*, which succeeded admirably in parrying any possible criticism of its realism by dispensing with it altogether!

This may well prove a strong argument with those producers who have not as much money as they would wish, and who pass on to their directors just a little less, knowing that whatever is budgeted is sure to prove insufficient!

Perhaps the logical result of this progression will be a return to the type of *decor* found in the Chinese theatre, where sets and properties were made conspicuous only by their absence.

The Problems to be Overcome

Compared with black-and-white, process projection in colour presents problems of a practical nature which must be overcome if adequate colour rendering is to be obtained from the projected image. These problems are:

- (1) The effective speed of colour film is lower than that of black-and-white film, so that to obtain a comparable result, more light is needed for the projected picture;
- (2) When the projected image is rephotographed the result is a dupe, which has been made by the sequence:

Negative—Colour Positive—Negative—
Colour Positive.

This is not necessarily the best sequence for making a dupe from colour photographs, but it is the only sequence possible in process projection.

- (3) The projected image as seen and rephotographed by the floor camera, must be in correct colour balance to match the live artistes and set which will be included in the composite scene. This colour balance comprises two quantities:
 - (a) The colour balance of the print being projected, as related to the original scene;
 - (b) Any overall colour introduced into the projected image by the projector

* Technical Research Department, J. Arthur Rank Productions, Limited.

optics, and the translucent screen or other media through which the light had to pass.

Starting with a colour chart, which has been prepared with poster colours for tests with colour film, the first step is to make an original Ektachrome of the colour chart.

Mr. Hoult then showed a series of slide which demonstrated the original Ektachrome plate and the loss in the first generation reproduction. He proceeded by a further series to demonstrate that this deficiency in copying could be overcome.

The colour reproduction, while quite satisfactory in the first-generation Ektachrome, is inadequate in the second-generation Ektachrome. This represents the problem which faces the technician who photographs back projection in colour. What can be done to improve this state of affairs ?

The method of achieving an improved match will now be described.

Materials for Duping Colour Plates

The problem is primarily one of duping a positive colour image. It is necessary to project on to the screen a positive colour image, so this part of the problem resolves itself into obtaining a positive colour image which is as faithful as possible to the original scene. The colours in the plate should match the colours of the original objects and the contrast of the projected image should also match that of the original scene : that is, the overall gamma of the reproduction should be approximately unity.

For still plates it has been found that these requirements are best obtained in Eastman Kodak Ektacolor cut sheet film.

Ektacolor is a negative-positive integral tripack colour process using a negative material which incorporates two degrees of automatic colour masking, and a positive material which will yield relatively low-contrast prints of high colour saturation and high definition. The fidelity of reproduction is high and the material will reproduce satisfactorily a long range of subject tones.

Any material used for making plates must be capable of yielding several positive copies. It must also be possible for the user to vary

the colour balance and density of the image in making the positive. These requirements are all met by Ektacolor.

For making 35mm. colour plates, similar considerations apply. A negative-positive integral tripack colour process offers the best prospects and there are in this field a wider selection of processes from which to choose. The most satisfactory results were obtained by the use of Eastman Colour Negative and Colour Print Film¹ which are of similar construction to Ektacolor and possess similar characteristics in their developed images.

Projectors and Screens

Having a satisfactory plate, a process projector and a translucent screen, it is necessary to project the plate on to the screen with as little loss in quality as possible. This is a major problem requiring a high-grade projector and a well-designed screen. There are to be found in the literature several accounts of process projection equipment, two of which were published recently in *British Kinematography*.^{2, 3}

It will be found that when projected by a process projector on to a screen, the plate will have assumed an overall cast of some unwanted colour. This may be due to the colour of the projector optics, the screen or of any other medium through which the light rays may have passed, including the glass of floor mirrors, which may be quite thick and appreciably green in colour.

The cumulative effect of these different elements is that the projected image of, say, a white object will usually appear yellow-green, compared with a white object in the foreground illumination.

Correcting the Colour Balance

It has been the practice of certain workers to offset unwanted colour cast by modifying the colour balance of the plate, but this is not sound practice. Consideration of this procedure will show that correction can only be applied to those tones in the plate which fall on the straight-line portion of the emulsion characteristics ; hence, both highlights and shadows become inadequately corrected. A more correct approach would be to stain

the plate all over with a uniform colour. A better method is to introduce a colour correcting filter into the projector beam, so as to neutralize the unwanted colour and allow the plate to be displayed in its true colours.

The discoloration is in general yellow-green, that is, the colours yellow and green may be present in excess in the beam of the projector. The source of these spurious colours is for the most part the colour of the glass of which the optical components of the projector are made. In a modern process projector there may be some 8 inches of glass in the light beam, made up of different glasses with different refractive indices and different colours. Blooming of glass-air surfaces may also be responsible for a colour bias, as may also the use of heat-absorbing glass filters such as Chance ON20 glass.

To neutralize a yellow-green colour is not an easy task, since the filter used for this purpose has not only to be of the correct colour, but should for preference be interchangeable among the several projectors in use at a studio. It must in particular be resistant to fading and damage caused by the intense light and heat of the projector beam.

This problem was overcome in two stages, by compensating separately for the yellow and green components. The unwanted green component is removed by fitting over the lens of the projector a magenta, or minus-green filter; the unwanted yellow is not removed but is balanced out by putting suitable yellow filters over the foreground lights. This leaves an overall yellowness in the composite scene which can readily be removed during the colour printing of the composite.

The magenta filter used on the projector was a problem for some time, because of the need for high optical efficiency combined with a high stability to fading. The type of filter now in use comprises an optical sandwich coating on a plate glass support, designed so as to have a peak reflection in the green and peak transmission in the blue and the red. These filters are resistant to heating and will not fade. They may also be incorporated in any of the optical components of the projector should this be so desired.

The yellow filters used on the foreground lights are usually extra thicknesses of a Y1 filter. A Brigham No. 53 filter may be used in lieu of two Y1 filters. Additional filters may be added as required to perfect the colour balance between foreground and screen. This may best be judged by comparing the appearance of a Technicolor lily, or its equivalent, held in the foreground lighting with a white light on the screen; that is, the light emitted from the projector with no film or slide in the gate. Under normal conditions the lily will match the screen in brightness and it should also match the screen in colour. Colour matching in this way is a very precise operation, provided a brightness match is simultaneously obtained.

A further series of colour slides was shown illustrating the mismatch due to unfiltered projector illumination also a method of correction using magenta filters.

Assessing the Colour Balance of a Plate

We have now established suitable operating conditions for the projection of plates which possess the correct colour balance. Responsibility for verifying that these conditions have been met should be assumed by the lighting cameraman on the production, since he will undoubtedly be blamed if anything goes wrong. It remains only to decide what is the correct colour balance of a plate. The colour balance is subject to infinite variation during printing, but is fixed by the time the prints are available on the floor. The appearance of a grey-scale is not a sufficient guide, for many colour processes of otherwise excellent quality are quite incapable of reproducing grey correctly.

The correct colour balance of the plate can be defined as being that which would enable the plate to be cut directly into the film without further ado. Assuming that the floor camera will give a faithful reproduction of the projected image of the plate, the composite scene will also be in correct colour balance for cutting directly into the film. Responsibility for approving the colour balance of the plate may thus be entrusted to some member of the production unit familiar with the scenes adjacent to the composite

scene. This responsibility should be vested in the art director, and he may, if he thinks fit, be guided by colour pilots of the adjacent scenes.

Safeguarding the Plates

To safeguard against damage, two or three copies of each plate should always be available on the floor. In the case of moving plates there are the risks of scratching and of damage to perforations. In the case of still

plates, there are the risks of fracture of the glass and fading of the image. It has been our experience that Ektacolor images tend to fade in the intense beams of the projectors. To prolong their lives, it is advisable to "save" them whenever possible and to use for lining-up a black-and-white print from the colour negative. If this is made to the same overall density as the colour print, it can be used for much of the time and will effect a considerable economy in the expenditure of colour material.

REFERENCES

1. Craig, G. J., "Eastman Colour Films for professional motion picture work." *Brit. Kine.*, 22, 146, 1953.
2. Ross, H. McG., "The heating of film and slides in projectors." *Brit. Kine.*, 16, 38, 1950.
3. Ross, H. McG., "A new still process projector." *Brit. Kine.*, 17, 158, 1950.

Mr. Hoult's lecture was exceedingly well supported by an excellent demonstration. It is deeply regretted that it has proved impossible adequately to reproduce the colour slides which were used to illustrate the author's argument, any paper colour printing process having failed to reproduce consistently the

shifts in colour balance which were so admirably presented to the audience by the transparencies.

For those members who were unable to be present at the meeting and whom the subject vitally concerns, the slides may be examined at the offices of the Society by arrangement with the Librarian.

II—THE PREPARATION OF COLOUR PLATES FOR STILL PROJECTION

M. E. Harper *

AS a result of our experiments to date, the most suitable material tried out has been Eastman Kodak Ektacolor, a sheet film negative-positive colour process which can be exposed in any normal still camera. Its low contrast makes it suitable for process reproduction, which always adds considerable contrast.

General Procedure

The still cameraman shoots plates on Ektacolor Negative Film using any standard camera.

The art director briefs the stillman on :—

- (1) Camera height ;
- (2) Camera level or tilt ;
- (3) Direction of the key light ; if exterior, this is the position of the sun (if any) ;
- (4) Time of day (this links with No. 3) ;
- (5) Focal length of camera lens. This is important, as the perspective must match with corresponding cine takes, especially if the plates are exteriors needed for reproduction in the studio with interlocking foregrounds ;
- (6) Composition of picture.

* Transparency Section, J. Arthur Rank Productions, Limited.

Ektacolor Negative Film is only supplied as Type B at present, so a Wratten No. 85B filter must be used when exposing to daylight or high-intensity arc. The use of other colour correction filters is not advised, as special colour effects such as night shots are best introduced during printing. The negatives should, therefore, be shot straight ; they will then serve for any type of effect that may be required.

Incorporation of a grey-scale in the picture is also unnecessary, as the colour balance is adjusted in printing to match the prevailing colour balance in previous scenes.

Printing the Ektacolor Negative

Ektacolor Print Film, designed for making colour transparencies from Ektacolor Negative is used for this purpose.

Exposure can be made by contact or projection. Projection is normally used as negatives are shot 5-ins. by 4-ins. and reduced to 3-ins. by 2.2-ins., the size of the projector gate.

The light source is incandescent at approximately 3,200° K. This colour temperature is not critical and adjustment can be made with colour correction filters on the enlarging lens. U.V. is permanently filtered out with a Wratten No. 2B filter over the light source. Colour control is obtained by using colour correction filters in combinations as required. These filters comprise a set of primaries—namely, red, green and blue, and their complementaries, cyan, magenta and yellow—3 of each in steps of 0.05, 0.10 and 0.20—18 filters in all.

Colour control is of such latitude that day shots can quite easily be converted into night shots.

When exposing print film it is advisable to adjust the exposure time by the lens stop in order to avoid the effects of differing reciprocity law failure in the three layers.

After processing and drying, the print film is fixed emulsion side down on to a 3¼-ins. by 3¼-ins. square of glass with 10 per cent gelatine solution. The acetate base is then stripped off leaving only the colour layers on the glass.

The colour balance must be agreed and fixed before slides are prepared for projection. Responsibility for approving colour balance is with the art director who usually matches the balance of previous scenes.

Once slides are made it is not easy to alter them. A certain amount of matching between screen and foreground can be effected by local colouring of the foreground with paint or light, or by directing additional lights at the screen. These are only makeshift methods and do not adequately replace a decision made in good time by the art director.

Similar considerations (apart from the need for monochrome lining-up plates) apply to the printing of 35mm. negative-positive colour films used as moving plates. This work is carried out by the motion picture laboratory.

(Mr. Harper concluded by showing a number of slides made as plates for the film Penny Princess.)

III — PROCESS PROJECTION EQUIPMENT AND TECHNIQUES REQUIRED FOR COLOUR FILMS

C. D. Staffell *

COLOUR film is slower than black-and-white film, so that for any given set-up more light will be needed on the screen when shooting in colour than would have been necessary for shooting in black-and-white.

It is always possible to build bigger and better projectors but there is a practical limit to the size and complexity of a process projector which is governed by the high cost of larger optics.

This demand for more powerful projectors has been well met in the equipment now in use at Pinewood Studios. A few examples of light output from earlier machines are given :

An early 35mm. Projector.

With 7-inch objective lens at f/2
Shutter stationary
Arc current, 200 amps.
Light output, 11,000 lumens

A modern 35mm. Projector

With 7-inch objective lens at f/2
Shutter stationary
Arc current, 145 amps.
Light output, 12,700 lumens.

With 200 amps., 21,800 lumens, with 285 amps., 27,750 lumens.

Thus, a modern 35mm. projector of similar rating gives out twice as much light as an older machine.

The Modern Process Projector

A Stereopticon, or still plate projector, with a 14-inch f/4.5 objective and an arc current of 285 amps., gave 43,000 lumens.

The most modern still plate projector—the Mark I manufactured by British Acoustic Films Ltd. and Taylor, Taylor & Hobson Ltd. gives a light output of 57,000 lumens, using a 14-inch f/4.5 objective and burning 285 amps. It has been achieved in the main by the use of a larger gate aperture (3-ins. by 2.2-ins.), which makes possible more efficient collection of the available light.

With all this light it may well be asked “What heat problems are there at the slide or film plane?” This problem has been studied by H. McG. Ross and is treated very fully in a paper published in *British Kinematography*.¹ The Mark I still plate projector was designed on the basis of his findings.

The Research Council of the Academy of Motion Picture Arts and Sciences of America suggest that an f/2 optical system for a background projector should pass a minimum of 16,000 lumens and maintain a 10 per cent uniformity of illumination over the screen area. What is of course important is the apparent brightness of the empty screen as seen by the camera. This depends on :

- (1) the total light delivered,
- (2) the illuminated area of the screen,
- (3) the angles subtended by this area at camera and projector lenses,
- (4) the polar diagram of the screen,
- (5) the camera aperture, which depends on the depth of field to be photographed,
- (6) the emulsion speed of the film used in the camera, and
- (7) the density of the plate being projected.

The solution depends on the total light available, which could be specified as follows :—

For Black-and-White Photography

Using the average screen size for normal shots :

<i>Camera Stop</i>	<i>Lumens</i>
f/2.5	2,700— 14,000
f/4.5	8,000— 43,000
f/6.3	18,000—100,000

* Process Projection Department, J. Arthur Rank Productions, Limited.

For Colour Photography

<i>Camera Stop</i>	<i>Lumens</i>
f/2.5	17,000— 84,000
f/4.5	50,000—260,000
f/6.3	120,000—650,000

Suitable Types of Still and Moving Projectors

We have at Pinewood excellent equipment, not only projectors but screens, screen-holders, meters for assessing exposure and density, floor mirrors (for “folding” the projector beam into a compact space) and a very comprehensive range of projection lenses, from a 22-inch f/4.5 to a 4-inch f/1.4.

However, the projector is the most important single item and the three principal types of projectors will be described briefly.

The J.A.R.O. 35mm. Single-Head Projector

This is assembled on a mobile platform (Fig. 1). The main column can be extended

manually to give a rise of 30 ins. from the base.

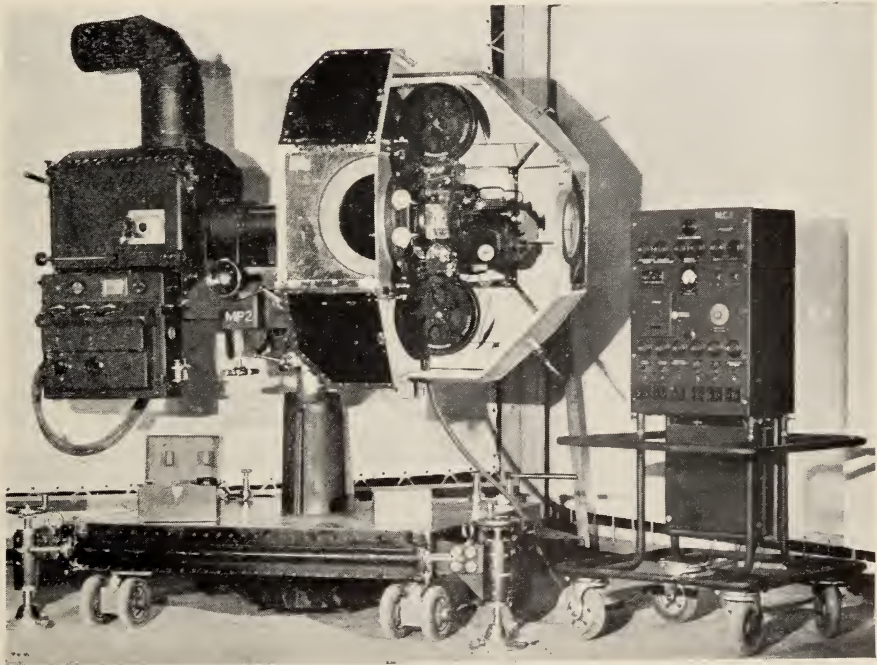
The optical platform carries the arc lantern, the cooling cell, the relay condenser, the light-controlling shutter, the projector head and driving motor, the objective lens and the blimp assembly. Optical alignment of these components is maintained by a common keyway on which they are mounted. Axial adjustments can be made accurately and quickly without upsetting alignment. The optical platform can be tilted and panned manually.

The arc lantern is the Mole-Richardson 1250B, using a 16mm. positive carbon and a 9mm. uncoated negative carbon. The positive head assembly is water-cooled. The feed for the positive carbon is automatically controlled by a photoelectric unit and two motors. The feed for the negative (which is also water-cooled) is by one motor and a variable potentiometer.

The light-beam is collected by the water-cooled first condenser unit which also contains a heat-absorbing glass filter.

The second or relay condenser throws an image of the first condenser on to the gate

Fig. 1.
The J.A.R.O.
35mm. Single-Head
Projector



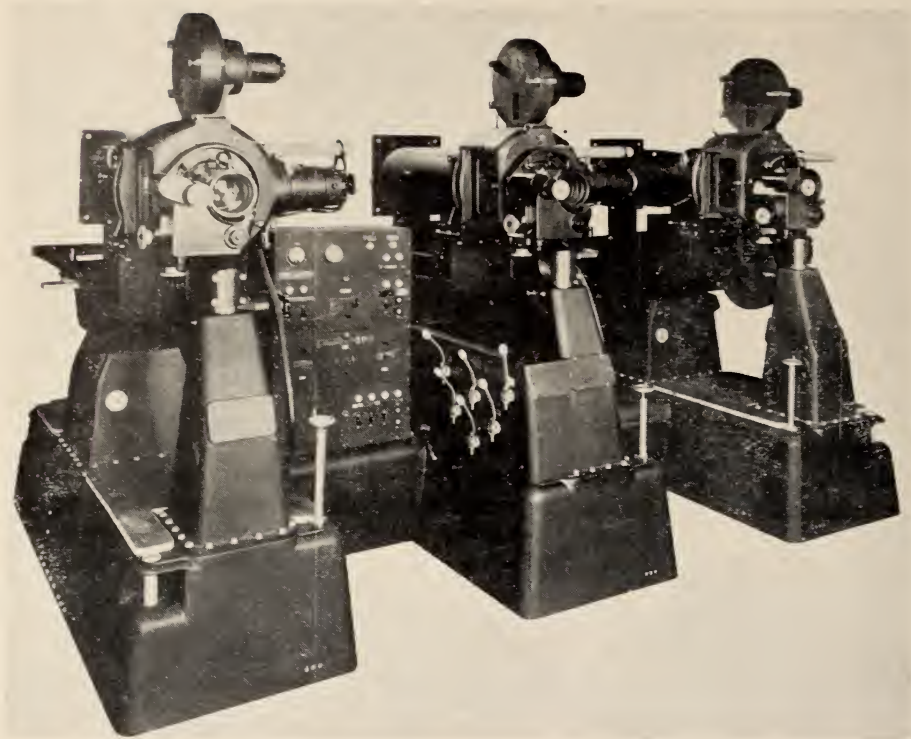


Fig. 2.
The J.A.R.O.
35mm. Triple-Head
Projector.

through which the film is moved by a Newall camera-type movement. This movement has been provided with a shrink adjuster—very useful when projecting “green” prints or for running in reverse.

The main driving motor and gear box operate through a clutch which can be disengaged while the projector and camera shutters are synchronized and the driving motors energized. The entire head assembly is blimped which renders it quite silent for use when recording sound.

The J.A.R.O. 35mm. Triple-Head Projector

This projector, shown in Fig. 2, is, in effect, three single-head projectors mounted on a common base. Each of the three heads is similar to that already described. Cross-motion of the lenses is used to effect superimposition of the three images. When several images from separate heads are to be superimposed a very high order of steadiness in the movements is required.

In both this projector and the single-head projectors remote control of the objective lens

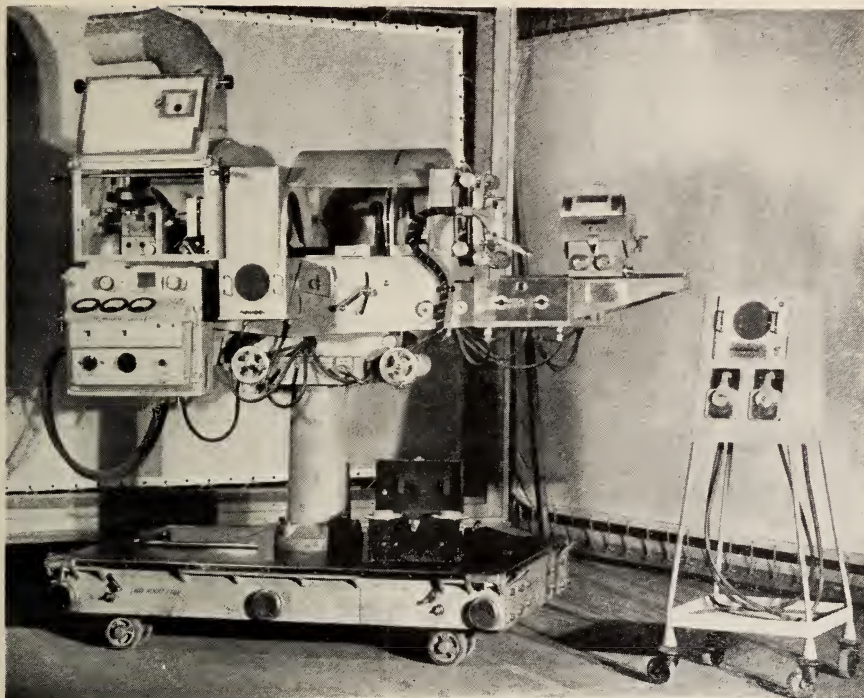
can be exercised from the camera position. In this way, it is possible to move the projected image horizontally and vertically, and to focus, while viewing the composite scene through the taking lens.

The J.A.R.O. Still Plate Projector

This projector, which was fully described in *British Kinematography*², is shown in Fig. 3.

Many of its features are based on the 35mm. projectors already described. Its light output is about double that of the 35mm. projector.

Equipment of this type opens up an extensive new field to art directors who have only had experience of 35mm. back projection. When, on location, action is covered by the still photographer, an inexpensive supply of background material is automatically obtained. These stills can often be utilized for still plate projection, readily enabling new scenes and inserts to be made and cut in with original location material.



*Fig. 3.
The J.A.R.O.
Still Plate
Projector.*

Multiple Projector Set-ups

The triple-head projector was made to provide three times the screen brightness possible from a single-head projector. This is achieved by superimposing three separate images on the one screen, by the use of cross-fronts on the lenses.

There are also occasions when it is required to superimpose the images from two or more of our single-head projectors, either for the same purpose or to give added flexibility to the set-up; or it might be required to superimpose the projected image from a moving and a still projector, such as when a cloudscape from a still plate has to be used with a seascape from a moving plate.

Having described the available equipment I should now like to describe my ideal 35mm. projector which, like all ideals, will probably never be realized. It would have the following features :—

- (1) absolute steadiness of the projected image over an area of 24-ft. by 18-ft.,
- (2) minimum buckle of film while exposed in the gate,

- (3) light output not less than 50,000 lumens at 200 amps.,
- (4) inaudible to sound recording when placed 20 feet from a 10-ft. by 8-ft. screen,
- (5) maximum accessibility and speed of operation on the floor,
- (6) minimum of maintenance,
- (7) a range of objectives of focal lengths 4-ins., 5-ins., 6-ins., 7-ins. and 8-ins., and
- (8) an optical system with an aperture of $f/1.4$.

Some of the lenses might prove a nightmare to the optical manufacturer, but we are now using a 4-inch $f/1.4$ lens, which might well prove to be the shape of things to come.

Modern Projection Screens

Process screens are of two types—front projection and back projection.

The requirements of front projection screens are relatively simple. A diffusing

surface of high reflection will ensure absence of hot-spot, combined with good efficiency.

It is not so easy to make back projection screens with a similar performance. In general it is preferable to use screens of relatively high diffusion. These screens, while having a lower transmission than earlier types of screen, suffer far less from hot-spot. Consequently the edge brightness is increased and the overall efficiency is increased in proportion. For a fuller explanation of these matters, may I refer you to the paper published in *British Kinematography*.³

The most important advantage on the floor of using high-diffusion screens is that they allow the use of shorter-focus camera lenses. It is now quite possible to project with a 5-inch lens and shoot with a 25mm. lens with no apparent degradation in the rephotographed image beyond that normally introduced by a wide-angle 25mm. camera lens.

(Mr. Staffell concluded his paper by showing a reel from the film *Penny Princess* in which *Ektacolor* was used for still plate projection for the first time.)

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3. Ross, H. McG., "High-diffusion screens for process projection." *Brit. Kine.*, 16, 189, 1950.

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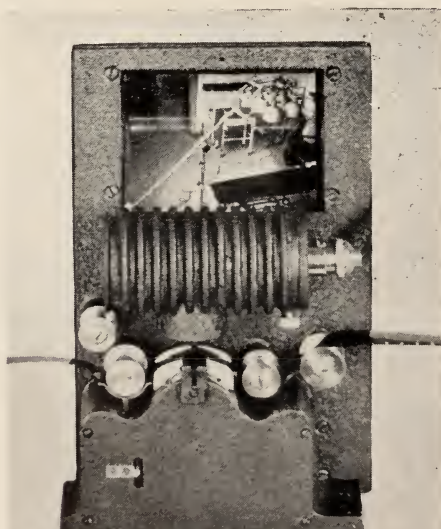
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SOME NOTES ON THE BRITISH STANDARD OF SCREEN LUMINANCE

F. S. Hawkins, Ph.D., F.R.I.C. (Fellow) *

THE British Standard specification for screen brightness as it was then called, was published in August 1947. It defined the desirable limits of the brightness of the centre of the cinema screen, the measurements being made normal to this point. It also contained a note which pointed out that further work was needed to enable a more comprehensive standard to be laid down and to discover the most convenient method of measurement. Since then a great deal of work has been done on these and similar problems which has culminated in a revision of the standard. It now defines both the desirable limits for the luminance of the screen when measured from any seat in the auditorium and the optimum diversity between the luminance of the side and centre of the screen. It also describes the conditions under which the measurements should be made and recommends a type of photometer for this purpose.

The work which has been done to establish the revised standard may conveniently be divided into three sections, viz. :

- (1) Experiments on the use of suitable types of photometer ;
- (2) Measurements of screen luminance in a representative selection of theatres ;
- (3) Experiments on the diversity between the side and centre of the screen, the diversity being defined as the ratio, side luminance/centre luminance.

The experimental side of the work was carried out principally by members of the staffs of the Ship Carbon Company, the Morgan Crucible Company, the British Thomson-Houston Company and the Research Laboratories of The General Electric Company. They worked both in the laboratory and in cinemas and are indebted to many

cinema managers and projectionists for their help in making the latter measurements.

Photometers

The recommended type is a visual photometer. Such a photometer is usually compact and convenient to handle when compared with a photo-electric photometer and will measure the brightness of a small area of the screen but has in the past been thought unreliable except in the hands of a trained observer. Before the recommendation was made investigations were carried out on the use of this instrument by unskilled observers and it was found that the accuracy obtained was sufficient for this particular purpose. A group of twenty observers was collected, sixteen of whom were entirely unskilled in the use of a visual photometer and most of them were making such measurements for the first time. They were requested to measure the luminance of a small area of screen which was also measured at the same time by a high precision laboratory instrument. The tests were carried out in conditions similar to those found in practice in a cinema and the results obtained have been fully published in a previous issue of this journal.² They show that eight of the observers obtained results within 5 per cent of the true value, six more were within 15 per cent, two were within 20 per cent and four, the remainder, within 22 per cent. It should be noted that the accuracy quoted for these results is the accuracy with which the absolute value of luminance in foot-lamberts can be determined.

If the same photometer were used to make purely comparative measurements, e.g. to determine which of two projectors produced the greater screen luminance, then greater accuracy would be expected from its readings, for a number of sources of error, such as loss

B.S. 1404 : 1953.

* Research Laboratories of The General Electric Company, Limited, Wembley, England.

of accuracy of calibration are excluded when comparative measurements are made.

British Standard No. 230 lays down limits of error for portable visual photometers. It states that the error shall not exceed 10 per cent of the indication of the instrument plus 0.001 candles/sq. ft. when the photometer is tested under laboratory conditions as laid down in this specification. These conditions are more favourable than those normally found in the cinema, and so the accuracy of a meter when checked according to this specification would be better than its accuracy when measured under its conditions of use in the cinema.

In the light of these considerations it was thought that the accuracy achieved with the recommended type of visual photometer was sufficiently high for this particular purpose.

The specification imposes certain limits on the photometer used, in that :

- (1) It has to be used from any seat in the cinema and must therefore be readily portable ;
- (2) It must measure the luminance of only a small area of the screen, viz., one which subtends an angle of 1° to the photometer. If this condition is not fulfilled erroneous results will be obtained when the luminance of highly directional screens of the beaded or metallized type is measured ;
- (3) It has to read down to 0.2 ft.-lamberts and have an accuracy of 20 per cent of the indication, regardless of whether the screen is illuminated by light having the spectral distribution of the high intensity arc, the low intensity arc, or even, on rare occasions, the tungsten lamp.

The effect of these limits was apparent at the time when photoelectric photometers were under consideration. It was found that while there were a number of photoelectric telephotometers which would measure screen luminances, sometimes with the highest accuracy, there was not one which fulfilled entirely the three conditions given above. In general, conditions 1 and 2 appeared to be mutually exclusive, for photometers which

measured the luminance of a sufficiently small area of the screen could receive from this area only a small amount of luminous flux. They therefore required amplifiers or sensitive detecting elements such as galvanometers to register such a small amount of flux and ceased to be robust and compact instruments which could readily be used in any seat in a cinema. The third condition raises the question of the effect of the spectral response of the photocell. A careful selection of the correcting filter for a photocell is required to prevent the accuracy of the meter from being impaired by the range of spectral distributions likely to be met in practice.

The advantage of a photoelectric photometer lies in the objective nature of its readings, but despite this merit it was found that for this particular application the most satisfactory type of meter available proved to be a visual meter. It was realised that future developments may alter this situation.

The Screen Luminance at present found in Cinemas

The revised standard quotes in appendix C the results of a survey of the screen luminance of thirty-three cinemas, which were selected as typical, were of various sizes and contained examples of all popular types of projection equipment and screens. It was found that one third of them had luminances within the limits of the definition given in the unrevised standard, and examples of all types of screen, including beaded, matt and back projection, were to be found in this group. The number of cinemas with luminances coming within the limits given in the new standard is much smaller, indeed only four cinemas comply strictly with it and all had matt screens. Four more cinemas comply with the new standard in respect of the luminance of the centre of the screen but do not come within the limits for the diversity of the luminance and three more are outside the central luminance limits by only a small margin. It is perhaps worthy of note at this point that the revised standard is essentially a practical revision; it does not represent an ideal that can be realised with difficulty, for the luminances it lays down as standard can be realised with any modern

installation, and not necessarily one of the most powerful and expensive type. Two of the four cinemas that complied strictly with the conditions of the new standard were burning 7mm. H.I. positives at 50 amps. in their projectors.

The Diversity of Luminance

The facility, available at the laboratories of the Morgan Crucible Company, for projecting simultaneously side by side, two pictures of regulated luminance brought out a number of interesting points on the effect of diversity on the viewing of the picture. The projection of black-and-white films rather than coloured was perhaps more interesting, because it posed a less complicated problem in which only contrasts in luminance were involved, with the exclusion of contrasts in colour.

In these tests one projector was set up to give a particular central screen luminance and diversity, the other was set to give the same central luminance; the diversity was altered. The central luminance was set within the limits given in the standard. Matched prints were then run through the two projectors.

Contrary to expectation small diversities, numerically greater than 0.8, did not produce the most sparkling picture. Simultaneous viewing of two pictures, both having the same central luminance, one having a diversity in excess of 0.8, the other being set

at 0.7 showed the latter to be the more acceptable picture. It had more life and sparkle and appeared to have the higher central luminance. This was an optical illusion arising from the greater contrast between the centre and edges of the screen when the diversity was 0.7. Further increase in diversity to values below 0.55 caused a hot spot to appear in the centre of the screen; the luminance in the corners became too low for comfortable viewing.

The Future.

The revised standard, which was completed at the end of May, 1953, was based on measurements made on screens of normal aspect ratio, between 10 ft. and 26 ft. wide, and intended to be used for showing two dimensional films. During the time the standard was prepared the three dimensional and the wide screen film had not arrived nor indeed had the news of their coming. Both of these types of film may involve processes of vision which are either not used or of minor importance in the viewing of the normal two dimensional film. It therefore appears that revision of the present standard of screen luminance will be required before it is applicable to the newer methods of projection, but it would be fair comment at the present time to say that the standardization of other features, particularly those involving dimensions of screens and projectors and the marking and identification of the prints appears to have the greater urgency.

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1. B.S. 1404 : 1953—Screen Luminance (Brightness) for the Projection of 35mm. Film.
2. Losty, H. H. W., and Hawkins, F. S. "Notes on the accuracy of measurements of the luminance and illumination of kinema screens." *Brit. Kine.*, 19, 77, 1951.

NEW BRITISH STANDARDS

B.S. 1985 : 1953 — Test Films for 35mm. Cinematograph Projectors.

In 1948 the British Standards Institution issued B.S. 1488 covering a series of test films for 16mm. cinematograph projectors.

Since that time consideration has been given to the preparation of standards for a corresponding series of test films for 35mm. projectors. Five standards have recently been published :—

- B.S. 1985 Part 1. Multi-frequency test films.
B.S. 1985 Part 2. Buzz track test films.

- B.S. 1985 Part 3. 1000 - cycle balancing and sound level test films.
B.S. 1985 Part 4. Sound focusing test films.
B.S. 1985 Part 5. Scanning beam uniformity test films (laboratory and service types).

Consideration was also given to flutter test films. It is not at present considered practicable to prepare any form of comprehensive standard for a test film,

but the Institution is giving consideration to the issue of a general memorandum on the subject of the measurement of frequency variation in sound recording and reproduction.

In preparing this series of standards a careful review was made of the corresponding standards of the Society of Motion Picture and Television Engineers of America (Z22.60, 61, 65, 66, 67, 68), and there is a close measure of accord between the essential requirements in the British and the American standards.

The standards are intended to provide a basis for the uniform production of test films for use by projector manufacturers, users, and service engineers. They specify the essential requirements of the films but not the methods of producing them, in order not to hamper technical progress in this field.

Each part prescribes the sound characteristics of the sound track and its dimensions and location in relation to the guided edge of the film. When appropriate, information is given as to the lengths of film which can be obtained splice-free.

Part 1 relates to a film for testing and adjusting the range and level of frequency response of the projector sound system at a projection speed of 24 frames

per second. The series of test frequencies covers the range 60 to 8000 c.p.s. and is suitable for both laboratory and service use.

Part 2 relates to a buzz track film for checking the position of the scanning beam.

Part 3 relates to a film for use in balancing the respective power level outputs from two or more projectors. This film, if calibrated and supplied with a calibration record, may also be used to determine the overall sensitivity of the sound equipment.

Part 4 relates to a film which may be used for the adjustment of the focus and aximuth of the sound-optical system in the projector.

Part 5 relates to a film for determining the uniformity of the scanning beam in the sound-optical system in the projector. Two types of film are specified, one with a sound track suitable for use in laboratories and the other with a track suitable for use in the routine maintenance and servicing of the equipment.

Test films should in all cases be regarded as pre-vision standards of reference, and since their careful storage is a matter of importance if their characteristics are to remain unaltered, each part gives detailed guidance on the manner of storing such films, which are required to be on a "safety" base.

B.S. 2013 x 2014 : 1953 — 8mm. and 16mm. Projector Spools.

Two comprehensive standards have recently been issued for projector spools for 8mm. and 16mm. cinematograph film (B.S. 2013 and 2014 respectively), and these two standards supersede the short schedules of dimensions which are included in B.S.677, "Motion picture film."

The standard for 16mm. spools covers seven sizes of spools from 50 ft. to 2000 ft. capacity, and that for 8mm. spools covers four sizes from 50 ft. to 400 ft. capacity.

The standards specify all of the essential dimensions, including the outside and core diameters, overall width and width between flanges, spindle mounting and drive, and accuracy of running. In the case of the larger 16mm. spools a maximum weight is specified in order that these spools when loaded and packaged may conveniently comply with postal regulations.

In preparing these standards care has been taken to avoid any unnecessary restriction to the freedom of design, but such essential requirements are included as will ensure that the spools are well constructed and will give satisfactory service. They deal with such matters as the attachment of the flanges to the hub and the accuracy of assembly, the ribbing of the flanges, the spindle clamping face, method of film attachment with its associated finger access holes, lightening holes and general finish.

The material is not specified as it is intended that the specifications should apply both to metal spools and to spools of non-metallic materials such as plastics.

For 8mm. spools and 16mm. spools up to 400 ft. capacity, two alternative forms of spindle mounting are provided, namely reversible and non-reversible

mounting, but in larger 16mm. spools the reversible mounting is the single standard method.

In preparing the standard for 8mm. spools the most careful consideration was given to the practicability of issuing a single common standard for spools suitable for both 8mm. cinematograph film and for magnetic tape for sound recording. It ultimately appeared, however, that the requirements associated with magnetic tape recording were such that any common standard would increase the cost of spools for 8mm. film and it was finally agreed that it was preferable for each industry to have its individual standard.

In preparing the standard for 16mm. spools the corresponding American Standard (PH22.11—1952) was reviewed. It may be noted that whilst there is a general accord between the British and American Standards, there are a few points of difference, in particular in respect of the outside and core diameters of the 800 ft. capacity spool which, in the British Standard, are smaller than the American. This latter point may require to be borne in mind by those who may be concerned with the export of 800 ft. spools, and film on 800 ft. spools, to America and certain of the Commonwealth countries.

It may not be possible for spool manufacturers to meet all of the provisions of these new standards immediately, but it is hoped that their acceptance by the industry will encourage the general adoption of a limited number of types, thus facilitating economic production, will ensure absolute interchangeability and will remove any difficulties or irritations which may in the past have been associated with spools for small gauge films.

B.S. 586 : 1953 — Photo-electric cells for sound film apparatus.

In 1935 the British Standards Institution first issued B.S.586 for photo-electric cells of the emission type for sound film apparatus.

One of the primary objects of that standard was to establish a simplified range of four cells from the great variety of sizes and types which were then in use. Unfortunately the standard sizes then chosen did not meet with universal acceptance and cells still have to be manufactured in a wide variety of types to meet the needs of individual equipment manufacturers.

The B.S.I. has accordingly given careful consideration to the revision of this standard, and a revised edition has recently been published.

This present edition, similar to that of 1935, relates solely to cells for use in sound film apparatus. The specified performance characteristics of the cells have been brought into accord with present day requirements, and anode voltage, sensitivity, dark current, variation in frequency response, gas factor, stability, and noise current are specified. A code system of symbols for designating the cell size, type of basing, and spectral response, is included.

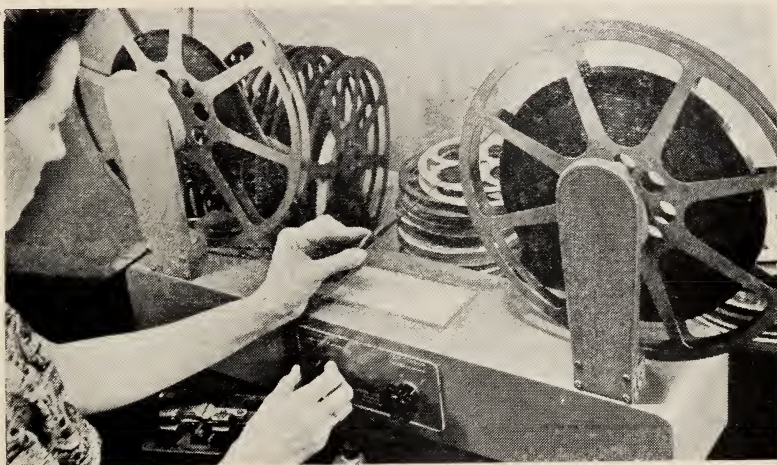
Owing to the great variety of sizes and types of cells already in use, the dimensional unification of cells necessarily presents very considerable difficulties. The B.S.I. Committee has, however, made a close study of the many existing cells and has made a selection of four sizes of cells, with associated types of basing, which are now put forward in this present edition of the standard.

It is appreciated that the design of a sound head may not always permit of ready alteration, and that for some considerable time it will be necessary for many types of cells to continue for replacement purposes. Nevertheless, in order to promote economic production and to facilitate rapid replacement, the B.S.I. most strongly urges that wherever possible, existing apparatus be modified to accept one of the cells now recommended, and that all new apparatus should be designed for the use of these cells.

Considerable importance is attached to the correct use of terms associated with photo-electric cells. A more extensive series of definitions is now included which will materially assist in a correct understanding of the terms used.

Copies of these British Standards are obtainable from the British Standards Institution, Standards House 2 Park Street, London, W.1.

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R.P.S. CENTENARY CONFERENCE

TO mark the Centenary of its foundation the Royal Photographic Society is holding an "International Conference on the Science and Applications of Photography" from Saturday, September 19, to Friday, September 25, 1953.

The aspects of photography covered by the Conference have been divided into five sections, one of them, Section B, being devoted to cinematography and

colour photography and Session 16 of Section C to high-speed photography and cinematography. Short abstracts of papers likely to interest our members are printed below, but full details are obtainable from Dr. R. S. Schultz, A.R.P.S., Hon. Secretary, R.P.S. Centenary Conference, 16 Princes Gate, London, S.W.7.

Section B. *Cinematography and Colour Photography.*

Session 11.

J. Friedman (*Anso Corp.*) Colour correction by masking.

The basic theory of masking : scope and limitations of various masking techniques.

K. I. Jacobson (*Photo Chemical Co. Ltd.*) Improved methods of grading and masking colour negatives.

Modern integral tripack negative-positive systems—grading by photo-electric and photographic methods : contrast and hue correction masks : integral masks, separate masks : a new colour masking material.

H. Berger (*Agfa A.C.*) The sensitometry of colour materials.

A. Marriage (*Kodak Ltd.*) Colour sensitometry by production of neutral image.

The use of cross-wedged exposures to find the combinations of red, green and blue exposures to give a natural scale : direct and accurate assessment of the speeds of the separate layers.

Session 12.

Dr. Luyten (*Gevaert Photoprodukten N.V.*) How can the interchangeability of commercial colour materials be achieved ?

Some suggestions for achieving interchangeability of commercial negative and positive colour materials : sensitometric characteristics : calibration of additive and subtractive printing systems : processing conditions.

A. Thiels (*Gevaert Photoprodukten N.V.*) A review of some characteristic features inherent in multi-layer processes.

The influence upon subtractive colour processes of the diffusion of developing agents and their reaction products : the variation of saturation of colour developed dyes as a function of their densities.

W. Grossman (*Photo. Institut E.T.H. Zurich*). The relations between sharpness and resolving power in colour photographs.

P. Vittum and A. Weissberger (*Eastman Kodak Co.*) The chemistry of dye-forming development,

C. H. Giles (*Royal Tech. Coll., Glasgow*). Studies on the light fading of dye in gelatine.

Session 13.

J. H. R. Coote (*Ilford Ltd.*) Demonstration of current colour photograph processes.

W. Hege (*Gelsenkirchen-Buer*). Colour photography (Agfacolor) in the service of art.

R. Pinoir, P. Baby, J. Faivre, J. P. Chouet and R. Aguiton (*Kodak-Pathé, France*). Photometric investigation of Photoflood lamps. Influence on exposures for Kodachrome film.

Session 14.

R. L. Houtt (*J. A. Rank Productions Ltd.*) A travelling matte process for monochrome photography.

T. W. Howard (*M.G.M. British Studios Ltd.*) Colour control in composite photography.

F. P. Gloyns (*Denham Labs.*) A method of chemical analysis for colour control in processing.

Section C. *Technique and Application of Photography.*

Session 16.

R. P. Fraser and N. Dombrowski (*Imperial Coll.*) High-speed photography in the study of moving fluids.

W. D. Chesterman (*R. N. Scientific Service*). World progress in high-speed photography 1935-1953.

D. W. Holder and R. J. North (*Nat. Phys. Lab.*) Schlieren and direct shadow methods for studying high-speed air flow.

J. H. Waddell and D. C. Gilkeson (*Wollensak Optical Co.*) Film on high-speed photography in industrial and military applications.

P. Devaux, P. Fayolle and P. Naslin (*Lab. Central l'Armement, France*). An electronic high-speed cinematograph camera and associated chronograph.

P. Naslin (*Lab. Central l'Armement, France*). A logical classification of high-speed cinematographic methods.

BRITISH KINEMATOGRAPHY

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VOLUME 23 No. 3

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

SEPTEMBER, 1953

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STEREO CINEMATOGRAPHY

A COURSE of Study on Stereo Cinematography will commence at Ealing Studios on Monday, November 2, 1953.

Six lectures will cover such subjects as stereoscopic vision, the basic principles of stereoscopic photography, stereoscopic projection, the geometry of stereoscopy, studio practices and special effects with stereoscopy.

Each lecturer is a specialist in his particular subject and the syllabus has been designed to include the many factors which must be understood by those seeking proficiency in this important technique.

Professor Wright, of the Imperial College of Science and Technology, an eminent authority on the physical aspects of stereoscopic vision, will give the first two lectures in which will be included the principles of stereoscopic photography.

The lecture on stereoscopic projection will be given by Mr. H. Dewhurst of the Telecommunications Research Establishment. Comparatively few technicians have had the opportunity to gain experience in this subject and it is indeed fortunate to have secured Mr. Dewhurst among the lecturers to the Course.

The remaining lecturers, Messrs. Nigel Spottiswoode, R. J. Spottiswoode and Charles W. Smith, who will speak on the geometry of stereoscopy, studio practices and special effects with stereoscopy respectively, are authorities in their particular fields. Those enrolling in the course will benefit greatly from the considerable experience of these pioneers in three-dimensional techniques.

The course will be of particular interest to studio personnel and to these and any others who may be interested, a request is made for early enrolment. Details are available from the Secretary.

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THE APPLICATION OF TELEVISION FOR UNDERWATER USE

by C. Hirsch,[†] G. T. Syminton[‡] and N. R. Phelp[‡]

*Read to a meeting of the Television Division on March 25, 1952, by J. H. R. Gilbert,
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TELEVISION was developed primarily to give entertainment in the home. It has gone a stage further than this and scientists and industrialists have been exploring the medium for use in many other spheres. The use of the television camera for underwater photographs is of special interest.

The film *Report from the Sea Bed*, made under almost ideal conditions near Malta, demonstrated the excellent results obtained in clear water and without artificial light.

The Camera Tube

The Image Orthicon has been used for this type of work because of its very high sensitivity, which is approximately one hundred times that of the Orthicon, and for its ability to produce a picture under the most adverse conditions. The Image Orthicon will transmit pictures of scenes illuminated by as little as 0.01 ft. candles and is completely stable over a light range of several hundred to one.

As might be expected, pictures transmitted at very low light levels may suffer in quality since, as the limit for sensitivity is approached, signal-to-noise ratio must be sacrificed to some extent. In addition, the resolution of the tube decreases owing to the effect of target leakage, and may be as low as 200 lines. At the higher light levels it is in excess of 500 lines.

Manufacture of the Image Orthicon Tube

Owing to its great complexity, the manufacture and processing of the Image Orthicon presents considerable difficulties. Each of the four main sections of the tube, i.e. photocathode, target, gun and multiplier, must be near perfect to ensure satisfactory operation of the complete tube. All assembly operations are carried out in rooms in which the tem-

perature and humidity are carefully controlled. Electrostatic precipitation is used to eliminate dust, and for the same reason operatives wear special clothing. Dust is the great enemy in tube manufacture, one small particle falling on the faceplate or the target may condemn a tube.

With the exception of the pinwheels and target mesh, the metallic electrodes of the Image Orthicon tube are fabricated from nichrome or stainless steel, these materials having suitable physical and chemical properties. Magnetic materials such as nickel cannot be employed, owing to the distortion of the uniform magnetic field.

The most critical stage in manufacture is the activation of the photocathode. The bismuth-silver alloy layer is evaporated on to the faceplate, to a thickness determined by optical transmission measurements. The layer is then oxidized by introducing oxygen at low pressure and initiating an electrical discharge.

The oxygen is then pumped out and the photo-cathode is caesiumed. This process takes place at a temperature of approximately 170°C., the introduction of caesium being discontinued when the sensitivity has reached its peak.

On completion of the pumping schedule the tubes are sealed off, and the 14-pin base is fitted.

After an ageing run the tubes are tested in a special camera to measure their characteristics. Those which satisfy the test specifications are then re-tested under field conditions.

Modifying the Camera

The equipment used so far for this application has been perfectly standard outside

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broadcasting camera channels, consisting of : the camera, the power unit, the camera control unit (incorporating the picture and waveform monitor) and the synchronizing generator. All this equipment can be operated on any of the three normal television standards, i.e. 405 line 50 fields, 525 line 60 fields or 625 line 50 fields.

The camera itself has been modified to provide essential remote facilities and indication. For instance a new right hand side has been fitted to carry the focus motor, the iris motor and its indicating potentiometer, the relay panel and the inclinometer. This side could be fitted to any of the cameras without any basic modifications to the camera or its circuitry.

The camera cable is terminated on a thrust block just inside the back of the camera casing and from there it is split two ways—one to the camera, terminated with an ordinary camera socket and the other to the remote control side panel with a 15-way socket. The wires for the remote facilities are obtained by using the talk-back circuits and other available spare wires, obviating the need to manufacture a special cable.

At the surface the camera cable is taken into a special control unit which houses the remote indication meters, the control switches and the flood alarm buzzer.

The camera cable is split again in this unit, the wires for operating the remote circuits being taken out here and those to the camera control by a short linking cable to the camera control unit.

It is not proposed to describe here the remainder of the television equipment as it is composed of standard units.

For the optical system it was decided to use as wide an angle of view as possible, the lens being a 35mm. $f/3.5$, with an angle of view of approximately 54° . The front viewing port in the pressure casing is of curved glass to compensate for aberration and curvature of field at the edges. Some thought was given to the fitting of a remotely controlled lens turret, but it was decided that this would create difficulty in keeping the camera on target when using a narrow angle lens. There

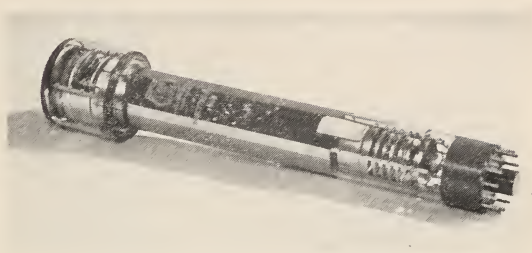


Fig. 1. The Image Oricon Camera Tube

is a possibility that some simple arrangement employing two lenses, say a 35mm. and 2-inch lens, might be of some assistance. Another reason for using a wide angle lens is that visibility in these waters is very limited, and, it is far better to manoeuvre the camera as close as possible to the target, obviating the considerable loss in picture quality which could occur were the camera placed at some distance.

Camera Cable Entry

In order to pass the camera cable into the pressure casing a gland must be used. The cable is similar in construction to many polythene covered conductors with a P.V.C. outer sheath. When passed through the usual packed gland with tightened gland nut to withstand the pressure, the continual pressure at the glanding joint results in indentation of the outer P.V.C. covering. This stress is transmitted to the polythene which, because of its "cold flow" characteristic, moves to either side so that gland efficiency is lost. In order to overcome this difficulty, instead of *packing* the gland, a rubber muff or sleeve 9 inches long is mounted over the P.V.C. outer sheathing as shown by section in Fig. 2.

The rubber sleeve is moulded with a lip approximately $\frac{3}{8}$ -inch in circumference which drops into a groove machined on the housing and in tightening the clamping ring down the rubber completely seals the machined groove against ingress of water. The pressure of water is applied radially to the outside of the rubber muff and gives a self sealing joint. A jubilee clip is mounted on the muff end tapering to cable diameter providing a self-sealing seal many inches long.

The cable itself is standard B.I. camera cable consisting of 4 coaxial cables and 28 single conductors, the only addition being an extra 100 mil P.V.C. sheath over the standard sheath; the diameter of the cable is slightly under one inch. P.V.C. although very durable, has the disadvantage that the cable is difficult to handle in cold weather due to the hardening effect—a condition often found in under water photography.

Design of suitable Pressure Casings

The design of pressure casings appears at first a simple task solvable by following the old well-tried principles, but certain special features more or less govern the design.

Having laid down the maximum depth of operation and margin of safety required, the container thickness and shape can be calculated. A spherical container is the ideal, but as it has to house a camera rectangular in

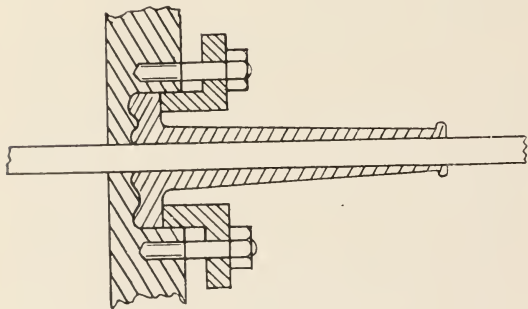


Fig. 2

shape, this results in a casing with a fair amount of waste space which is larger than desirable. A cylindrical container is easier to manufacture and gives less wasted space internally. Although tides will have greater effect the housing can be finned so that it takes position in the tide.

Glandings

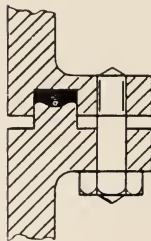
All glands must be watertight to a pressure exceeding the working depth and to the margin of safety desired. This can be considerable and at a 1,000 feet working is to the order of 440 lbs. per square inch. Many types have been tried but the two types shown

correctly proportioned give the best results. Porosity in the glanding material cannot be tolerated.

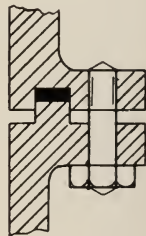
From the two figures in Fig. 3 it will be seen that 'b' is purely a variant of 'a', the difference lying in the spigot shape; the glanding material must not be of the type that gives a permanent set when mated for long periods and the shore hardness should be carefully chosen.

The grooved spigot at B ensures a longer water path in the event of leak and allows the glanding material room to move with increasing pressure; when the joint is made initially it need not be fully tightened, the pressure at increased depth giving a self sealing joint.

It will be noted that both spigots have a "lead" in the glanding groove and that the groove is only partly filled with glanding



(a)



(b)

Fig. 3

material. This ensures concentricity so that mis-mating which would be liable to happen were this precaution not taken, cannot occur.

P.V.C. and rubber of requisite shore hardness have been used as glanding materials. Although P.V.C. has a slow recovery from permanent set it does not shear so readily as some rubbers.

Underwater Visibility

Visibility under water can vary over a wide range. Most British coastal waters are rather poor in this respect, particularly in the neighbourhood of estuaries such as the Thames and the Mersey, where visibility is

Fig. 4. *The first experimental assembly.*

almost nil due to the enormous quantities of solid matter held in suspension. But when very clear water is found, off Malta and Cornwall for example, it is possible to see considerable distances by daylight only.

To obtain reasonable results in most British waters it is necessary to use artificial light, but this presents the difficulty of placing the lights. The best position is as far away as possible and behind the lens so that the minimum amount of spill occurs.

There appears to be no particular advantage in choosing lights with a specific colour temperature in using colour filters. The data obtained by Hulbert (giving absorption and scattering against wavelength) off the coast of America shows this quite well. The American bay water is similar to very good British coastal waters and is what we would interpret as oceanic.

These remarks apply only to television, as the spectral response of the Image Orthicon is similar to that of the human eye slightly extended at both ends of the curve.

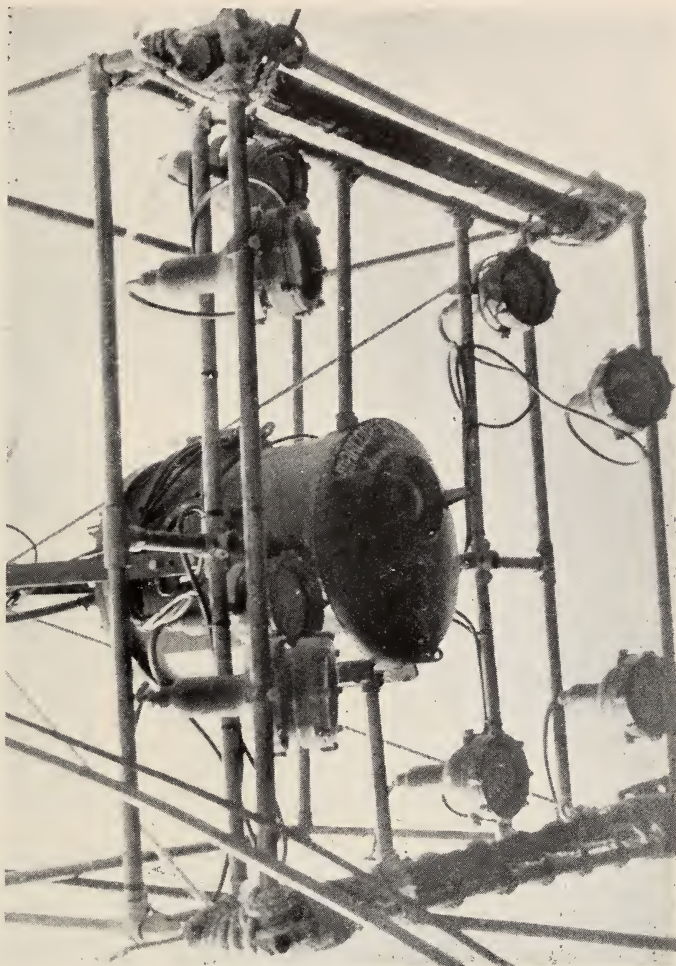
For photography it would be advantageous to use filters with certain types of emulsion.

Lighting

Various light sources are available for underwater use and as the conditions under which they are used are so variable it may be of interest to examine them in detail.

The most commonly used lamps are :—

1. Tungsten
2. High-pressure Mercury vapour
3. Sodium.



Tungsten has the advantage that no inductive surges are necessary to start them ; when working at extreme depths the inductive striking surges can easily be lost in the long outgoing cables, assuming that the ballasts are retained on surface. To overcome this the ballast could be submerged with the television equipment. The efficiency of discharge lighting can be from three to five times greater than that of tungsten, but because of the many problems involved in using discharge lighting under water, tungsten is at present used. Various lamp housings have been designed giving flood and directional lighting. To illuminate a fixed area at given range, as the first experimental assembly

required, eight 150-watt spotlight reflector lamps (each giving a beam angle of 30° in water) were used in pressure tight housings.

The lamps were mounted on a tubular gantry so that they would illuminate the target area evenly. In turbid waters illumination is exceedingly difficult and the viewing range is limited. To assess the percentage of light transmission in water a hydrophotometer is used. This consists essentially of a lamp and lens assembly at the one end and a photo electric cell at the other with a $\frac{1}{2}$ -metre path between. The photo cell is fully modulated in daylight and lowered into the water, the reading obtained indicating the percentage light transmission in water. The accuracy of the instrument in turbid water is adequate, but when used in clearer waters the accuracy is inadequate, a difference of a few per cent. giving a great change in visibility.

Method and Equipment used for Recording

A test was made in the Channel last year but as specially developed film recording equipment was not available at the time, the basic components were assembled to form a rudimentary recording system as shown in Fig. 5.

The picture from the television camera was displayed on a standard demonstration monitor using a 12-inch diameter cathode ray tube with a so-called white screen. A metal-backed phosphor on the tube helped to maintain the required brightness and contrast. The

tube was supplied with E.H.T. at 8.5 kilo volts and run at a peak current of 100 micro-amps. The television standards were 625-line 50 fields interlaced using a 4 to 3 aspect ratio. The normal picture size was reduced to 6 inches by 8 inches in order to minimize the effect of tube face curvature, and under these conditions a highlight brightness of 50-ft. lamberts was obtained. Past experience had shown that at this brightness Super X reversal film and a lens aperture of $f/2.8$ gave sufficient exposure.

A Cine Kodak Special 16mm. camera was mounted on a framework rigidly fixed to the monitor. The whole assembly was mounted on castors for easy manipulation, but was securely lashed in position on board.

It was originally intended to use the Kodak 63mm. telephoto lens at $f/2.7$, as this was known to give a good image at the required conjugates, but owing to space restrictions on board it was necessary to reduce the focal length to 50mm. As this lens has a maximum aperture of $f/1.9$ an increase of two to one in exposure was obtained. A difficulty frequently encountered in recording television pictures on film arises from the



Fig. 5

difference in frame blanking time in the television system and pull-through in the film camera. The pull-through and exposure times in the Cine Kodak Special are approximately equal so that at 25 frames per second only half the television information per frame could be recorded. By using a 2 : 1 interlaced raster one field could be recorded whilst the other was ignored as it occurred during the shuttered time. With this arrangement some 300 television lines were recorded in the camera frame height of 7.5mm. resulting in an image on the film of about 40 lines/mm. Due to the form of the light distribution in the C.R.T. spot no lininess was observed in the recorded picture. Experience has shown that very acceptable pictures could be obtained at this standard of definition.

The synchronous camera motor was driven from the generator which supplied the television equipment. The synchronizing pulses were sufficiently rigidly locked to the supply frequency for there to be negligible float between camera and television. A simple stroboscopic viewing device was fitted in the camera driving shaft to show when the phase of the motor was such that the camera shutter was open at the correct time. Failure in this respect results in a "shutter bar" appearing in the picture due to the finite time taken for the shutter to uncover and cover the lens aperture.

Underwater Difficulties

The difficulties encountered in handling the equipment are numerous. The greatest problem is getting the camera to point at the required target. Obviously when the unit is on the end of several hundred feet of non-spin cable it is extremely difficult to manoeuvre the camera at all—particularly in a tideway. It is possible to control the camera to some extent by the use of a shot wire attached to a second derrick and with a heavy shot weight on the end. The shot wire is attached to the camera, but allowed to run free. The camera can then be controlled by raising or lowering the shot and by moving the two derricks relative to each other. The ship can be moved by mooring fore and aft to buoys

(in the case of working over a wreck) and paying off or taking up on the appropriate winches.

Applications

The number of possible applications for underwater television which spring to mind is apt to be bounded only by the imagination but some of the more obvious applications of general interest are :

- (a) Sea-bed survey,
- (b) Salvage and ship's hull inspection,
- (c) Dock and harbour work survey,
- (d) Marine biological and oceanographical research,
- (e) Fisheries.

Sea-bed survey for determining the nature of the sea-bed surface is of considerable interest to oceanographers and forms perhaps the simplest application. Some incidents from trials undertaken by the Admiralty illustrated the possibilities although the existing simple equipment was not specifically adapted to this task, nor was this application directly under investigation.

On the occasion of a demonstration, a diver was sent down to operate underneath the camera at about 120-ft. depth. The nature of the bottom was determined from the screen as being of coarse gravel ranging from $\frac{1}{2}$ -inch to 3-inch with a slight admixture of coarse sand. The diver was instructed to gather a sample, which he was observed to do. Examination of this completely confirmed the detailed information obtained from the screen. This result was obtained with the camera some 10 to 15 ft. above the bottom, a closer approach being impossible due to lack of remote optical focusing.

One of the objects investigated in the search for the "Affray" was a formation on the bottom revealed by echo-sounder to be semi-circular in plan, some $\frac{1}{4}$ -mile across and rising to a height of 50-60 ft. from the sea-bed, rather like a circular disc half buried at an angle in the bottom. As a possibility existed of the "Affray" being close to the steep edge of this formation where it might not be distinguishable acoustically, it was investigated by camera, the depth being rather more than

200 ft. A search of about an hour covered most of the surface and showed that it was a smooth, featureless sand hillock, devoid of even marine life with the exception of a solitary crab. These formations occur frequently in the Channel. Investigation by bottom sampler reveals their nature but not the detailed structure or configuration of the surface.

Another example of a sand formation occurred in the vicinity of Smith's Knoll where a series of regular waves about 15 ft. high and 700 to 800 ft. long was observed by echo-sounder at a depth of about 16 fathoms. The camera showed them to be fine sand, the

survey may be summarised as follows :

- (a) The camera is capable of working deeper than a diver and for even longer periods than an observation chamber,
- (b) There is no risk of life,
- (c) The picture is presented directly to experts on the surface and not by verbal descriptions,
- (d) Manœuvring is enormously simplified by the direct observation.

The base of manœuvring renders the use of salvage grabs, etc., relatively simple. It is a fascinating experience to place a diver's shot line, salvage grab or other device, solely



Fig. 6. The seabed, showing shoal of fish on left. This picture is by daylight only.

surface also bearing the small ripple formation often found on the sea-shore. This fact could not have been ascertained by any method other than diving. As the ship was not even moored for this investigation, the speed and simplicity of the television method is obvious.

The presence, distribution and appearance of rock and weed formations are also most easily investigated visually since any normal bottom-sampling method is confined to scattered points.

The application to salvage operations was, of course, vividly illustrated by the "Affray" operations. The major advantages in wreck



Fig. 7. The break in the snorkel mask of the "Affray."

with the aid of the camera, accurately to within a few inches. The sense of intimacy is so great that it is difficult to believe that the object in view is some hundreds of feet below the sea surface.

The inspection of ships' hulls below water, and dock and harbour survey work may be considered together because they present normally similar conditions. The turbid nature of the water in most British harbours means that limited use only is practicable. Some work has been done in an undisturbed non-tidal basin where sedimentation has produced a usable transparency. If, of course, a very limited field of view is required and a

correspondingly close approach is feasible, television may be of some use. In Malta however, a photographic survey has been made of dock walls ; and it is evident that in particular localities visual methods are practicable.

The use of underwater television as a research tool is fascinating to the scientist. Apart from the work of Beebe and a few other similar exploits, little use has been made of visual methods in oceanographic research. Some work has been done in photographing the sea-bed at great depths and also in continuously photographing a strip of sea-bed, but such shooting is of necessity "blind" and the subject-matter included is purely a matter of luck.

The study of marine life in its natural habitat is now greatly facilitated and problems such as the "false bottom" echo obtained in many parts of the world on echosounders, a phenomenon not yet satisfactorily explained, may be investigated with ease.

Another more general application is to use the television chain as a visual link to transmit information to the surface from instruments placed in the field of view of the camera. Although the television link is in itself complex, this may well prove a more flexible method than providing each instrument with recording or remote reading facilities with their attendant uncertainties.

The marine biological applications are, of course, of interest to the fisheries, but it is possible that more direct uses may be found, such as searching for flatfish which, normally living on the bottom, are not distinguishable acoustically. The behaviour under working conditions of trawls and nets has already been studied photographically and may well be more conveniently investigated by television.

Stereoscopic Underwater Television

Experience with wreck survey operations using underwater television, particularly the

work on H.M.S. Affray, has led to the conclusion that a stereoscopic presentation would prove valuable in some circumstances. A preliminary set-up for this purpose has been on trial but has so far been prevented by bad weather from use under water.

The arrangement is simply a mirror system placed in front of a $1\frac{1}{2}$ -inch camera lens giving two side-by-side L. and R. pictures on the monitor screen. The mirror system is such that no transposition of the pictures is necessary and the monitor screen is viewed through an ordinary binocular viewer. The success of such a simple system depends entirely on the linearity of the camera and monitor horizontal scans and it was somewhat surprising that fusion of the two pictures could be achieved. The other severe limitation is the very narrow field of view (about 25° by 18° under water) due to the splitting of the field and the necessity of using a flat camera window without the auxiliary lens system normally used to obtain a wide angle into water. Any practical arrangement would undoubtedly use a field-sequential system (alternate R. and L. eye views), the limitations of the observation equipment necessary being acceptable for underwater use.

Conclusions

The conclusions are that underwater television is obviously a valuable tool and at present it is impossible to envisage all the potential uses to which it can be put. Nevertheless with the experience already attained, and with smaller cameras and precise positioning arrangements, it would be easier to go to far greater depths.

Acknowledgement

Thanks are due to Marconi's Wireless Telegraph Co. Ltd., for permission to publish the paper, to the Admiralty for certain data, and to the English Electric Valve Co., for the information on the Image Orthicon Camera Tube, and to Siebe, Gorman & Co. Ltd.

DRIVE-IN THEATRES

W. Flaherty

Read to a meeting of the Leeds Section on December 9, 1952, by A. Buckley (Member)

THE Drive-In Theatre provides sound motion pictures projected in the open, and the combination of this form of entertainment with facilities of every kind, including food, non-alcoholic drinks, recreation and amusement for children, provides unusually attractive entertainment for the patron—and profitable business for the exhibitor.

The Location of the Site

Most favoured sites for drive-in theatres are those on the outskirts of a town, since accessibility for patrons from both the city and rural areas is important. The location should be near to but not on a main road, in order to prevent traffic congestion while filling and emptying the theatre.

The cost of grading the ground, preparing ramps and providing drainage of run-off water are serious items to the prospective builder. The ramp is a specially shaped and prepared area where the car is parked whilst its occupants watch the show. The ramps are arcs of concentric circles with the centre at the screen or screen tower, Fig. 1. The service loop allows space for cars waiting for vacant ramp space, similar to standing room in a conventional theatre. Since considerable grading is necessary, and the cost of earth moving is high, the builder must find a site which will require little expenditure and still be in an area which will attract the public.

Types of Theatres

The size, or car-holding capacity of a drive-in, will depend upon the estimated revenue. Under this heading can be included the population of the adjacent city, the expected rural patronage, location, the type of patron expected, and competition from other drive-ins, either actual or proposed. A home-made drive-in, giving the bare essentials of operation where the owner does much of the

construction work, may be built for about \$20,000 (£7,140). It might be said to consist of a cash register, a screen and projector, and a gently rolling hillside. Strangely enough many of these low cost theatres have proved very profitable. On the other hand, there are the luxurious theatres, which provide baby sitters and a playground for children in the space just in front of the screen. One theatre in Florida is reputed to have a choice of either warm or refrigerated air available to be blown into each car. Of course, the admission prices will vary according to the luxury provided. A typical small drive-in with a 300- to 400-car capacity will either charge about 50 c. (3s. 7d.) for each adult in the car, children being admitted free, or will make a flat rate for each car regardless of occupants. A large proportion of the income is derived from the sale of food, drink, etc.

The type of patron expected decides the money expended and the admission price. If the location is near a district of predominantly lower income groups, refinements in the theatre are few and the price of admission low. If located in the summer resort area where the patrons are holiday makers, the trimmings are more elaborate and the prices higher. In southern U.S.A. the operating season may be as long as nine or ten months of the year. In the north the theatres are open from May to November or until snowfall ends the season.

Concessions

Usually the building which houses the projection facilities also contains the concessions, that is, the food sales organisation. With taxes and ever-increasing overheads, the American exhibitor needs a supplementary source of income, and this accounts for the prominent position in the design of these theatres given to the concession stand. When it is realised that from 30 per cent to 50 per

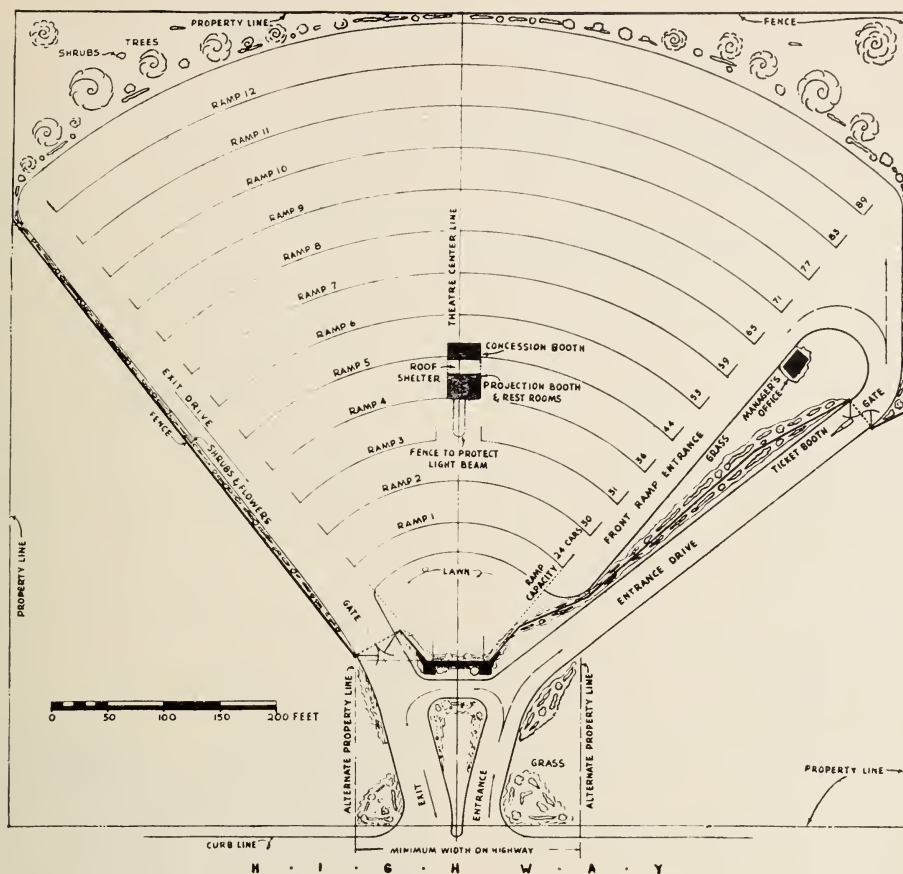


Fig. 1. Layout of typical drive-in theatre.

cent of the income of a drive-in is from the concession stand, it is easy to see the importance of the concession building. The concession dispenses candy, pop (ginger beer), pop-corn, hot dogs, ice cream, etc., and this results in a small projection room and a large concession stand.

The drive-in is fundamentally a motion-picture theatre moved outdoors, the sound being distributed to each car. There is a volume control fitted on each car-speaker so that the patron can regulate the volume to suit himself. It may sound simple, but with 40-foot wide screens 150 feet away, and 100 to 500 watts audio power spread over 300 to 900 speakers the projectionist's task is not always easy.

Ramps

After a particular site has been approved for construction the next question, depending on the slope or on the "levelness" of the land, is the type of ramp to be used. One of the many types used has either the front or back wheels of the car in a shallow ditch, thus giving the desired slant towards the screen. This method has the advantage of a lower initial outlay, but its application is limited and there is the disadvantage of some difficulty in entering and leaving the ramp. The other, and most used type of ramp, may be compared with a series of concentric waves in the ground radiating from the screen. Fig. 2 shows a cross-section of one such wave. It will be seen that the purpose of the ramp is to

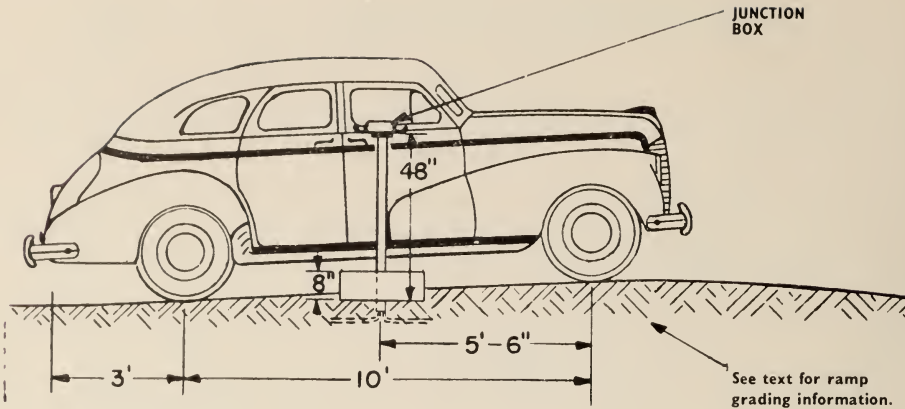


Fig. 2.
Cross-section
of ramp.

tilt the car so that the screen can be viewed by the occupants while sitting in the same position as when normally driving along a road. Since the centre line of the screen is from 35 feet to 65 feet above ground level, it is necessary to slant the entire car towards the centre of the screen. Each arc of ramps is progressively further from the screen, so the angle of tilt on each ramp will become less as the distance from the screen increases. It is also necessary to provide an unrestricted view for each successive row of cars; the top of the car in front must therefore not obstruct the view of the car behind it. Probably the ideal grading system and land location is one where the screen is set on a slightly higher spot than the last arc of ramps and the ground slopes gently from the screen tower to the last ramp. This also simplifies the question of drainage, for if the drainage is inadequate and the ramp surfacing poor, a rainy evening and several hundred cars can make a quagmire of a drive-in, causing costly regrading of the ramps. If the natural slope of the land will not provide surface drainage an underground system of ducts is necessary. The surface of the ramps and connecting driveways must be durable and some luxurious theatres have asphalt surfaces, although the majority use a mixture of crushed rock, coarse gravel and sand, coated with heavy road oil and rolled. The oiling and rolling is repeated at intervals, depending on wear and tear and climate.

The ramps are usually about 40 feet apart, thus allowing cars to enter and leave easily. The first ramps should be at least 100 feet from the screen, although a distance of from 130 to 150 feet is preferable. Of the 40 feet allowed between ramps, about 18 feet is slanted for parking the car. A width of about



Fig. 3. Motiograph in-car speaker and junction box showing volume control knob on speaker and neoprene covered cradles.

10 feet is allotted for each car and for placing a speaker post and its concrete base. The remainder of the ramp width and length is allowed for the car to drive into and out of the ramp. The recommended procedure is to drive the car forward on to the ramp and when leaving, drive forward into the space ahead and out to the right. To back the car out of the ramp is not considered good form.

As mentioned earlier, the ramps must have a certain slope in relation to each other and the screen. Every patron knows the distortion caused by viewing the screen from a seat at the side of the theatre, and the same effect is noticeable in a drive-in. For that reason, cars are usually confined to an area of about 40° on each side of a line perpendicular to the centre of the screen.

Sound Systems

The first drive-ins were primitive affairs and depended on a "blast system" to distribute sound to the cars. Powerful loud-speakers were hung on the screen tower and on poles placed about the ramp area. With this method patrons nearest the speakers had too high a level of sound, and people in adjoining houses and farms could also hear the sound. Nowadays, a separate speaker is fitted in every car with an individual volume control. Each speaker post carries two speakers, and when not in use, the speakers rest in cradles on the post top. They are connected electrically to the post junction by flexible cables. When in use, a speaker is lifted from its cradle and hooked on the inside of the car door. When the patron is about to depart, he unhooks the speaker and replaces it in the cradle on the post. The cost of damage caused by forgetting to replace loud-speakers is an appreciable figure during a season and various methods have been tried to prevent it. One expedient that worked too well was attaching the speaker to the concrete base by means of a steel cable. When the car was driven away with the speaker still on the door, something had to give way with the result the car door was damaged. In one instance the door was torn off. Repairs to loud-speakers are mainly to volume controls, diaphragms,

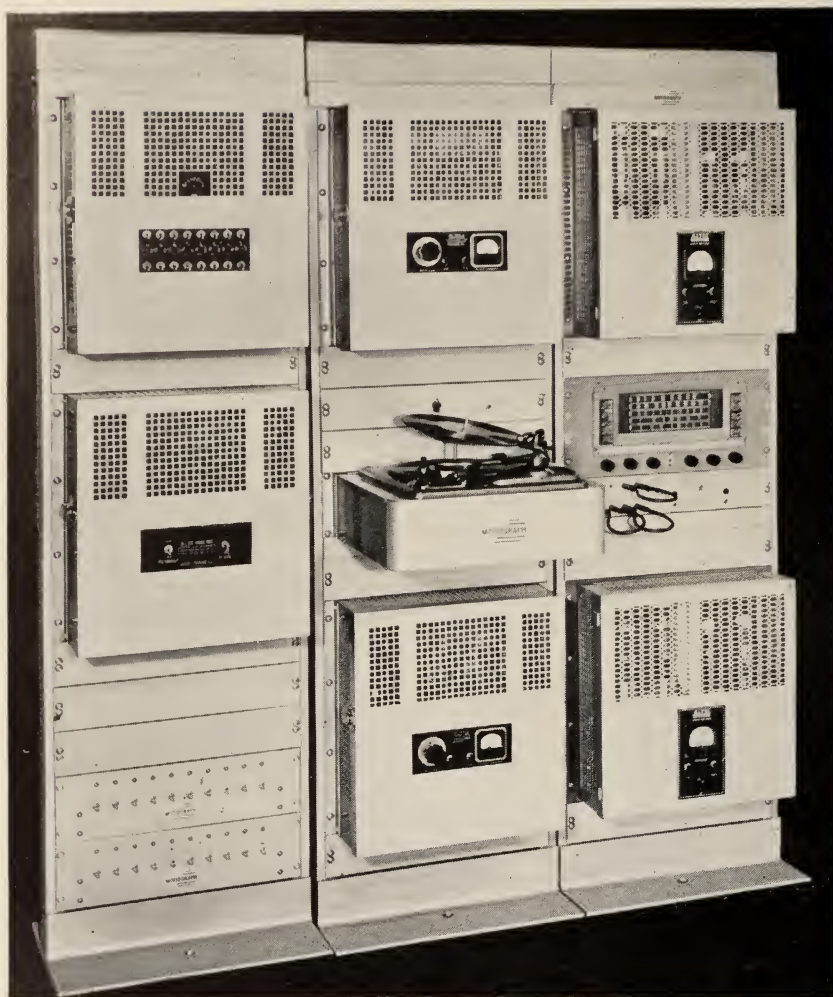
and wiring. About 2 per cent of the total number of speakers must be allowed for maintenance. At the end of the operating season the speakers are taken down from their posts and stored indoors.

The output of the amplifiers in the projection room is fed to the speaker post junction boxes by underground cables. Usually the ramps are divided into sections with a switched feed line from each section to the amplifiers. In this way a short circuit or earth at one post will not affect the sound for the entire theatre, since the defective portion can be switched off and an equivalent resistance switched in to balance the load. Some of the more elaborate theatres have a paging switch on each speaker. When this switch is turned on, it flashes a light in the concession stand to indicate that a particular car wants something. In this system, two sets of wiring to each car are necessary, one from the projection room and one from the concession stand. A three-wire underground cable is used in this instance, one of the conductors is common earth and the others carry the audio and paging circuits.

The Projection Room

The projection room is usually in the same building as the concession stand, rest-rooms, storage rooms, etc. Because of the limitations of space the projection room is small and has low ceilings. The entire central building must have a low vertical outline in order to give a clear view to cars in outlying ramps. As a result of this, the lens ports are just above ground level and the floor of the projection room is considerably below ground level. This presents the problem of excluding surface drainage water from the room during heavy rain. Projection rooms are commonly made of either cement block or hollow tile. Fire-proofing depends upon local laws and in some cases is non-existent.

The projectors used are of the conventional theatre type with rear shutters. The drive-in projector must be tilted up to the screen rather than down as in the average theatre. If a standard projector base is used, it is necessary to place blocks under the front end



*Fig. 4
Motiograph
sound system,
including lamp
switching panels,
turn-table record
player and radio.*

of the base. It is much simpler to use a base which allows easier tilting and provides a steady foundation for the projector. Most American projectors are intended to have excess oil drain to the front of the mechanism. In drive-in projectors the oil drainage is in the opposite direction and this becomes a problem.

Suprex lamps using copper-coated carbons and operated at 60 to 80 amperes are favoured for the smaller theatres. Larger theatres require higher intensity lamps burning about 150 amperes. The exhaust outlets from the lamps are usually less than 5 feet from the lamp housing to the roof. Sometimes a strong

wind will blow back with consequent flickering of the arc and even cause damage to the reflectors. Since drive-ins are in a semi-rural location the power is frequently drawn from lines having an unsteady voltage. This unsteadiness may be abrupt and irregular, or it may be a steady decline which begins about the time the show starts and reaches its lowest point about 10.00 p.m., when it starts to climb again. By closing time it may be 10 per cent to 15 per cent above normal. In some instances, the line voltage has dropped from a normal of 117 volts to 85 volts. The effect on light and sound can be imagined, and it will be appreciated that the projectionist has to be

on the alert. Smaller drive-ins tend to use dry plate rectifiers as lamp current source; the larger ones prefer the motor-generator with its additional advantage of freedom from small line voltage fluctuations.

Screen sizes vary from 40 feet to 53 feet in width, needing projector lenses of fairly short focal length. If the throw is too great very high current is required for the arc, and if the throw is short, the focal length of the lens becomes very short, and the point of diminishing returns is approached with wide projection angles and consequent distortion. Coated lenses of high quality are needed to squeeze the maximum light from the projection system.

Perhaps the greatest point of difference between the drive-in and the ordinary projection system is in the amplifier power and the amplifier layout, Fig. 4. The large number of speakers absorb a higher amount of audio power than the usual movie theatre. Small drive-ins may find that 70 watts is sufficient, but 900 car theatres will need 500 watts output from the main power amplifier. In general practice the output transformers have multiple secondary connections, each secondary tap feeding one ramp section with 20 to 40 speakers in that section. At least one spare power amplifier is kept in readiness, and can be switched into the circuit in case of failure of another amplifier.

The cables carrying the audio signal to the speakers are laid about 18 inches underground. They must be under the surface far enough to be protected from the blades of earth-moving machinery and yet not so far as to increase cost of installation when the theatre is built. They must also be readily accessible for replacement or repair.

Closing a Theatre

With the approach of winter the theatre has to shut down for a few months when the temperatures often fall as low as 30° below zero. The intermittent movements are drained and all excess oil wiped out of the machines and sound heads. Generous amounts of cellulose fibre are packed into the machines

to absorb any oil seepage. The projectors, motor-generators, amplifiers, etc., are covered with canvas to keep out dust and moisture condensation. The lenses are removed to a place where temperature variations are not so great and where humidity is more nearly constant. Some owners make a practice of suspending a 100-watt bulb in each amplifier section, these burn all the winter. Such a procedure seems costly, but it pays for itself during the summer months in prevention of breakdowns. The screen tower is left all the winter, and is given a coat of paint in the spring.

The Screen Tower

Some screen towers are prefabricated, being factory made in various sizes and moved to the site of the drive-in and assembled. The screens are usually made of an iron framework, imbedded in concrete bases heavy enough to withstand the stress of gales. The main members are 3-inch or 4-inch angle iron, and the cross-members of lighter material. To these cross-members are bolted the flat sections comprising the screen sub-base and over these is nailed the 4-ft. by 8-ft. sections of waterproofed plywood of the screen surface. The plywood is spray-painted with several undercoats and a final coat of white matt paint. The black masking is painted around the border to suit the size picture.

Another common practice is to combine the screen tower with the administrative offices, ticket office and advertising marquee.

Competition with the Cinemas

Since the drive-in theatre is in operation for only a few months of the year there is a tendency for the film-renting companies to favour the ordinary theatre that operates all year round. However, in the last few years drive-ins have had such profitable business that they are in a position to compete with the city theatres in the bidding for later release pictures. But the general feeling seems to be that drive-in patrons are not greatly concerned with the age of pictures; they seem to be content with second and third run pictures.

It must be admitted that the drive-ins have taken a large share of the summer business from the city theatres showing later pictures. Many of the owners of these have built drive-ins to meet the competition. This is understandable, since the drive-in, during its season of operation, pays a larger return on money invested than the city theatre. At first, it was thought in the film industry that this form of theatre was just a novelty, but time has shown this to be wrong; drive-in theatres are steadily increasing in numbers as well as volume of business.

BOOK REVIEW

Books reviewed may be seen in the Society's Library

THE PRINCIPLES OF CINEMATOGRAPHY.

Leslie J. Wheeler, F.R.P.S. (Member). The Fountain Press, pp. 472, 63s.

In the foreword to the book a former President of the B.K.S. says: "This book... is to be welcomed as a serious effort to cover a very wide field. It is perhaps inevitable that people with specialized interests... may feel that their particular aspect has been dealt with in less detail than the subject requires."

The present reviewer regards this as a most fair and accurate assessment. It may be questioned whether it is wise to attempt so much in one volume at a time when each branch of the technology of motion pictures is so specialized. Colour photography is not mentioned, stereoscopy is given three pages, wide screen presentation is not mentioned. Such are the penalties of the effort to be all-embracing in a science allied to the unpredictable entertainment world, where progress has always been made in very large steps in large periods of quiescence.

The book will give an excellent general background to the student, the apprentice, the beginner, before he must start his specialization. It is marred by bad editing—the constant misspelling of "logarithm"—the recommendation to dry wet film at 180°F.

In spite of these criticisms, the work is such that, if the B.K.S. new grade of membership (now open to what Mr. Wheeler calls "serious workers in 16mm.") should grow, it is hoped that the B.K.S. Library will purchase several copies. The hundred pages devoted to 16mm. work are excellent.

R.J.T.B.



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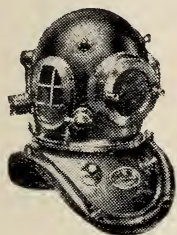
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VIIIth ANNUAL CONGRESS OF THE INTERNATIONAL SCIENTIFIC FILM ASSOCIATION

This year the Annual Congress of the I.S.F.A. was held in London and was organized by the British member-body of the I.S.F.A., namely the Scientific Film Association. Thanks to the foresight of the British Film Institute an excellent venue was already available in the National Film Theatre, and the Royal Festival Hall provided a meeting place for the General Assembly as well as facilities for Group papers and discussions.

Twenty-seven countries were represented at the

Congress and films were submitted by twenty-four of them.

The films selected for the two Gala Film Performances were of an exceptionally high standard and while some were of the popular science type others demonstrated high specialized scientific techniques. All were worthy of the occasion.

A most happy departure was that during the period of the Congress a total of 28 hours was allocated to the public screening of films.

PERSONAL NEWS OF MEMBERS

Members are urged to keep fellow members conversant with their activities through the medium of **BRITISH KINEMATOGRAPHY**.

The President, Baynham Honri, F.R.S.A. (Fellow) and Gordon Dines, B.Sc. (Member) were recently elected Fellows of the Royal Photographic Society.

Walter Lassally (Associate-Member) photographed *Sunday by the Sea*, awarded the Grand Prix for the best short film at the Venice Film Festival for 1953.

G. J. Craig (Fellow) will visit Rochester, New York and Hollywood during October.

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VOLUME 23 No. 4

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

OCTOBER, 1953

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THE CONQUEST OF EVEREST

FORTHCOMING lectures are seldom the subject of editorial comment, but there may be occasions when the outstanding technical interest of the subject matter to be discussed, or the outstanding ability and success of the lecturer are such that the attention of members can quite properly be directed to the meeting. These reasons prompt us to comment upon the lecture to be delivered at a meeting to be held by the 16mm. Film Division of the Society at Film House on the evening of December 22.

Mr. T. R. Stobart, B.Sc., F.R.G.S., had already attained a wide reputation for his successful cinematographic records of modern expeditions, including journeys into the frozen wastes of the Antarctic and the tropical heat of Central Africa, before being invited to undertake the formidable task of recording the epic story of "The Conquest of Everest."

It is probable, in view of the heavy cost of equipping modern expeditions, that the financial reward likely to be derived from the subsequent commercial exploitation of the film record will, in the future, be an important economic factor to be taken into account at the preliminary stages of planning an expedition and preparing its budget. Indeed, it is expected that professional film technicians will be indispensable members of future expeditionary undertakings.

Assignments of this nature call for many special qualifications, foremost of which are a rugged physique capable of contending with the extremes

of adverse weather conditions, and the ability to overcome the discomforts and inconveniences necessarily associated with such expeditions. At the same time, the cinematographer must have a sufficient reserve of physical and mental energy to apply himself to the initial task of picture making. Although he may prepare some preliminary plan before he embarks upon his task, he must, nevertheless, be both director and script writer—directing and writing his script as he goes along. Whilst keeping constantly in mind the primary necessity of making a coherent and accurate record of the expedition, he must, also seize every opportunity that presents itself and turn it to the best advantage. In addition, he must be a complete master of his equipment, be fully experienced in the many techniques and processes involved in the making of a motion picture, and be able to obtain the best possible results under difficult conditions of weather and of lighting.

The British film industry can be proud of its tradition in the making of historical, documentary and record films. Over forty years ago, Mr. H. C. Ponting, F.R.G.S., F.R.P.S., accompanied Captain Scott to the Antarctic and made a film record which won wide praise. "The Conquest of Everest" is a film which will enjoy a similar, if not a greater, prestige.

We therefore look forward with pleasant anticipation to Mr. Stobart's lecture, in which he will deal with the many technical and other problems that were involved in making this film and the manner in which he overcame them.

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WATER EFFECTS

R. L. Hoult, A.R.P.S. (Member) *

CONSIDERABLE use is made in film production of water effects of various types—rain, sea-scapes, rivers, to mention only three. When these can be shot in the natural state, there are few special problems for the cameraman. Frequently, however, these effects have to be reproduced artificially in the studio, either at full scale or on a reduced scale. It is here that a detailed knowledge of the behaviour of water is of real value to the technician, who cannot hope to obtain realism unless he observes the natural laws which govern the behaviour of water in motion.

These notes are concerned primarily with the behaviour of waves in water. As such, they should be of interest to all film technicians at some time or another. They will be of particular interest to cameramen who wish to shoot model boats and sea-scapes.

Wave-Motion

Wave-motion is the most common means of transferring energy in the natural state. Heat and light from the sun are the consequence of electro-magnetic waves reaching this earth. Sounds, the cries of animals and the speech of men, are the result of waves transmitted through the air. The rise and fall of the tide, no less than the disturbed surface of the sea during a storm, are examples of wave-motion occurring in the surface layer of water. By means of this wave motion the seas move, land is washed away from our coasts and ships are thrown on to dry land and wrecked. In all these examples of wave-motion, one characteristic is observed in common—the transference of energy by means of the wave. The power of the sun in supplying heat is only evident because we perceive this heat arriving at the earth : and the power of the sea is no less evident, when one considers how easily it can wreak destruction.

For the understanding of wave-motion it is essential to grasp the fact that it is above all else a method of transferring energy, of providing a source of power which may be dissipated or harnessed, but which must be recognised as clearly as one recognises the power of a vehicle in motion. Because a water-wave is not merely an artistic creation but an active physical agent, it is necessary to expend power in its generation, in its control and in its destruction. This is an important factor in the design of ships, for a ship passing through water generates waves : this generation requires the expenditure of power, which comes from the ship's engines. By reducing the tendency to produce waves, therefore, economy is effected in the design of the engines. Moreover, because a wave is a source of power, and because this power is dispersed in travel by friction, waves at sea exist only because they are being continually supplied with power—from the wind, in a manner which will be shown later. When the wind drops the sea becomes calm, to be ruffled only by some other source of power such as a ship passing.

Water Waves (General)

It is very seldom that one sees a single wave on a water surface. Usually the whole surface is covered with waves with an irregular and ever-changing pattern. A simpler display is produced by a stone falling into a still pond. Here we see a series of circular waves form. These travel outwards from the centre with a certain velocity and in time die away. Just as a point disturbance such as a stone falling will produce a circular wave, so will a line disturbance produce a straight wave, such as those we see coming in and breaking on to a beach. In plan, waves can be of any shape : in section they are all of similar shape. The shape of the cross-section of a water wave is approximately that of a trochoid, i.e. the

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* Technical Research Dept., J. Arthur Rank Productions Ltd.



Fig. 1. Diagram of a Trochoid.

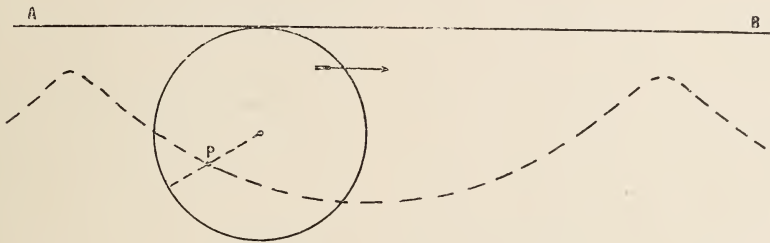


Fig. 2. Generation of a Trochoid.

locus of a point on a radius of a circle which rolls along a given straight line (Fig. 1).

The geometrical construction of the wave shape is seen in Fig. 2 which shows the generation of a trochoid by the Point P on the radius of the circle which rolls along the underside of the line AB. In practice it is formed by the movement of the water itself, the individual particles travelling in circles, which become smaller the deeper the particles.

The paths of three particles of water, C, D and E, in the wave which is travelling in the direction of the arrow are shown in Fig. 3. It will be seen how the phases of C and E are the same, while D is of the opposite phase. It is also seen how the orbits of the particles below C decrease below the surface: the diameter at the surface being a while the diameter at a depth d is a' . Approximately we can say that there is no wave motion occurring below a depth d , and that it is confined to the surface layer of the water only.

The distance between the nearest points at which the wave-motion possesses the same phase is known as the wave-length and is denoted by λ . When the wave has travelled from C to E, all the particles have made one orbital travel. The time for this to occur is known as the period and is denoted by T . The wave moves at a certain velocity which we denote by V . Then

$$\lambda = V.T.$$

It can also be shown that when $d = \lambda$,

$$\frac{a'}{a} = \frac{1}{e^{2\pi}} = \frac{1}{535} \dots\dots\dots(1)$$

that is, at a depth equal to CE the wave amplitude a' is only 1/535 of the surface value, a , and may in fact be regarded as non-existent for most purposes. The significance of this is that the depth of the water does not affect the wave-motion, provided it is of the order of the wave-length on the surface. It should not be less than $\lambda/4$.

It should be noted that the above considerations apply to a true trochoidal motion. Water waves resemble this closely but not exactly. In the extreme case, the maximum height wave obtainable from a trochoid is a cycloid, the locus of a point on the circumference of a circle which rolls on a given straight line. Fig. 4 shows the generation of a cycloid. This shape is never obtained in water, the nearest being one in which the angle $\alpha = 120^\circ$ with a sharp ridge to the wave. Then the maximum value for the ratio

$$\frac{d}{\lambda} = \frac{\text{wave height}}{\text{wave length}} \text{ is } \frac{1}{7}.$$

If it is attempted to produce waves higher than this, the crests break (as in the formation of "white horses" at sea) and limit the height. Fig. 5 shows the sharpest crest which can be obtained in a water wave in deep water. In practice, waves may be as large as 600 ft. long and 1/7 of this in height

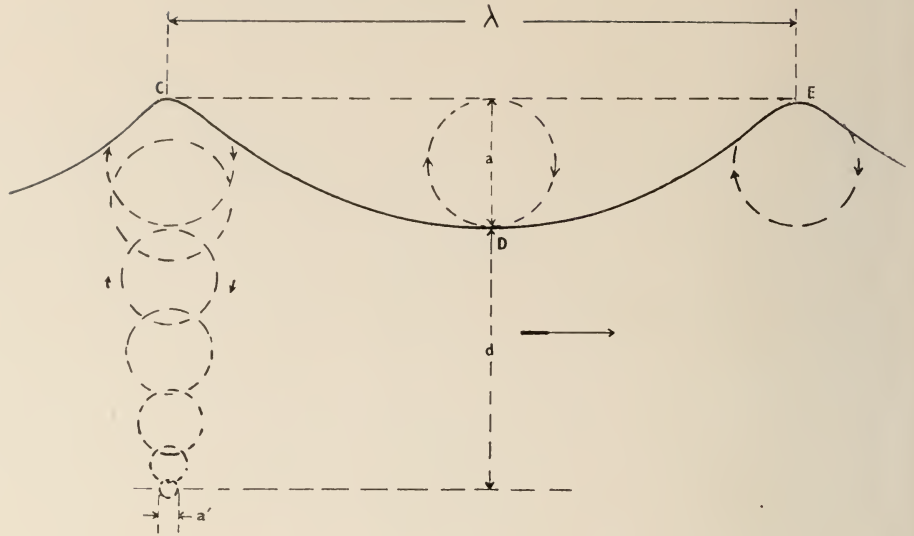


Fig. 3.
Generation of
a water-wave.

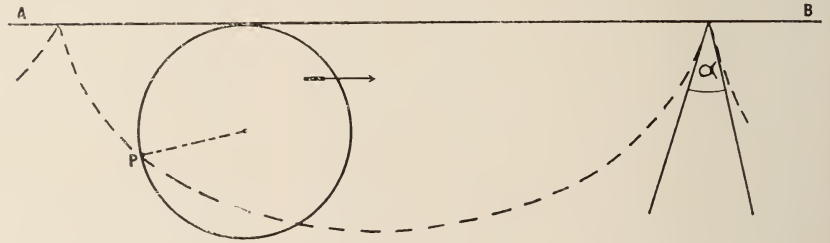


Fig. 4.
Generation of
a Cycloid.

in an Atlantic storm and some waves $\frac{1}{2}$ -mile long have been observed on occasion.

By analogy with the trochoid, the height may be any fraction less than $\frac{1}{7}$ of the length, as obtained by moving P towards the centre of the circle in Fig. 2. When P is at the centre, no wave results, corresponding to a calm surface.

The velocity with which the wave travels is related to the length of the wave by the relation

$$V = \sqrt{\frac{g \cdot \lambda}{2\pi}}$$

where g is the acceleration due to gravity ; that is the velocity is proportional to the square root of the length. Hence the longer the wave the faster it travels and vice versa, but there is a lower limit to velocity.

The waves we have considered so far are "gravity waves," in that they owe their

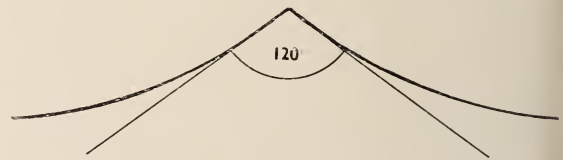


Fig. 5. Sharpest water-crest in deep water.

form and propagation to the effect of gravity on the water particles, causing them to fall in their downward paths and opposing their upwards motion, as a pendulum is gravity-controlled. It is also possible to produce waves which are controlled less by gravity than by surface tension. Surface tension is the property of a liquid whereby its surface exhibits elastic properties, as though covered by an elastic film. It is demonstrated by the formation of drops on a greasy surface and the curvature of the surface where it meets an immersed wall. Such waves in a liquid are

known as capillary waves and possess different properties from gravity waves. Their shape is not trochoidal but more nearly sinusoidal and their velocity increases as their length decreases. They are generally of very short length and period and are to be seen in puddles in which rain-drops are falling. We have the condition, then, that as we reduce the length of gravity waves, their velocity decreases up to the point at which they turn into capillary waves owing to their small size. Thereafter the velocity increases as the wave length is decreased. These effects are shown in the graph in Fig. 6.

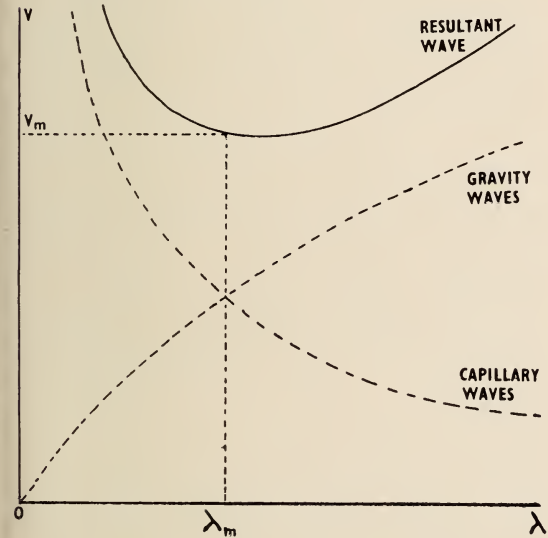


Fig. 6. Relation of velocity to wavelength of water-waves.

There is thus a minimum value for V which we denote V_m . At this velocity the wavelength is denoted by λ_m . For water :

$$\lambda_m = 0.68 \text{ ins.} = 1.73 \text{ cm.} \dots\dots\dots (2)$$

$$V_m = 0.78 \text{ ft./sec.} = 23.2 \text{ cm./sec.} \\ = 0.45 \text{ knots.} \dots\dots\dots (3).$$

In practice capillary waves are indentified with ripples. The significance of this is that gravity waves cannot be produced with a smaller velocity than 0.45 knots.

So far we have considered waves in deep water, that is water whose depth is greater than the wavelength. We will now consider the effect of shallow water.

If the depth is decreased to the extent that

the orbits of the particles tend to interfere with the bottom, then these orbits become distorted and the wave motion modified. Water (or any fluid) is deemed to move in layers in the presence of a stationary surface. Consider the flow of water in a trough, a section of which is shown in Fig. 7.

It is considered (and can be justified) that the layer of water in contact with the bed is at rest. The layer on the surface is certainly in motion. The intervening layers move with different velocities, depending on their depth. Thus, when a wave motion passes through shallow water, the orbits next to the bed must degenerate to points and the remainder must be compressed so that the movement of the water is restricted by the friction resulting from the nearness of the bed. The lower orbits become ellipses. When very shallow, the velocity of the wave



Fig. 7. Flow of water in a trough.

ceases to depend on the wavelength and is governed by the depth, d , the velocity decreasing as d decreases.

Another factor to be considered is that which causes the "heave" of the sea and the setting up of surges in tanks used for wave-making. The motions of a fluid under the action of a wave can be divided into three kinds :

- (i) Translation
- (ii) Strain
- (iii) Vorticity.

So far we have considered the most pronounced motion of water in waves, its orbital motion or vorticity (iii). One should also consider the elasticity of the fluid and the wave-motions arising from strain (ii). Water, however, is so very incompressible that this factor is ignored. The third kind of motion, translation (i) is a bodily surge of the water in the direction in which the waves are travelling. This is an inescapable consequence of wave-motion ; it diminishes with depth.

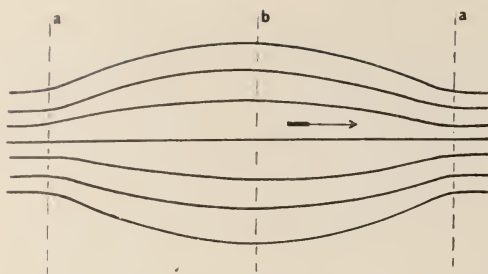


Fig. 8. Flow of water through a pipe of varying cross-section.

We can now attribute the breaking of waves on a beach to a combination of two effects at least :

- (a) Due to shallowness, translation in the surface layers is proportionately greater than in the bottom layers and induces a falling forward of any wave travelling up the beach ;
- (b) Due to slope, the front wall of the wave is in shallower water than the rear wall : the front portion of the wave therefore tends to travel more slowly than the rear portion, which induces a tendency to fall forwards.

Origin of Waves at Sea

We will next consider the origin of waves at sea. As stated in the opening paragraph, it is not sufficient to create waves : they must be maintained or they will rapidly die out by loss of energy in the friction of the orbital movements of the water particles and to a lesser extent in the "heave."

When two immiscible fluids in contact possess different relative velocities, wave motion is generated at the interface. This can be proved by the following considerations. Consider the flow of water through a pipe of the shape shown in Fig. 8.

Let it be supposed that the cross-section of the pipe at the planes *a*—*a* is the same, but is larger at *b*, then the velocity of the water at *b* will be lower than at *a*—*a*. It will be found by experiment that the pressure at *b* will be greater than at *a*—*a*. This is in fact a property of fluids in motion, that a decrease in velocity is accompanied by an increase in pressure. Consider now the interface between the air and the sea where the air (wind) is moving

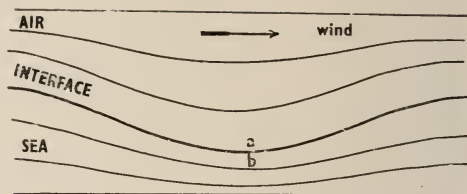


Fig. 9. Generation of a disturbance in a water-surface.

over the sea at a certain mean velocity. Now the wind is never of exactly the same velocity at all points on the earth's surface, owing to local currents, obstructions, etc. Hence there is an uneven distribution of pressure over the surface of the sea and the sea is thus depressed locally into small troughs and waves, so a disturbance is generated (Fig. 9).

At the position *a*, the cross-section of the air stream has been increased and the pressure therefore increases, tending to depress further the water surface. Thus the depression is unstable and once formed it tends to be increased until the displacement is balanced by gravity. We have the same effect when a flag is flying. It is the interface between two adjacent streams of air. Given a small depression in one side, e.g. in Fig. 9 at *a* the pressure increases and at *b* it decreases (since the air-stream here must increase in velocity). The depression is unstable and the flag flaps without any control until the depression extends beyond the end of the flag and the surface becomes sensibly flattened. Then the conditions reverse and the flag flaps back the other way and so on.

Having obtained a disturbed surface on the sea, consider the action of the wind on the waves as in Fig. 10.

The wind blowing over the tops of waves strikes the crests and produces eddies on the far side. This is a common phenomenon, that a fluid flowing past an obstruction causes eddies to form on the sheltered side. The air is thus in quicker motion in the sheltered troughs behind the as yet stationary wave than on the exposed wall where, owing to the slope, a pressure is developed with a component normal to the water surface. The

pressure on the sheltered side is, however, reduced. There is thus a net pressure tending to drive the wave before the wind. In this way, the wind maintains the wave-motion and generates a wave train from a local disturbance. It is clear from this explanation that the waves must travel slower than the wind, for otherwise their relative velocity would drop and the net pressure maintaining them also drop. Hence for any given wind there is a maximum velocity which can be imparted to the waves and at which they can travel. This is approximately 80 per cent of the wind velocity. Likewise there is a maximum wavelength which can be maintained (since $\lambda \propto V^2$), and a maximum height ($d = \lambda/7$). The tendency is, therefore, that as the wind drops, the waves become shorter as well as lower.

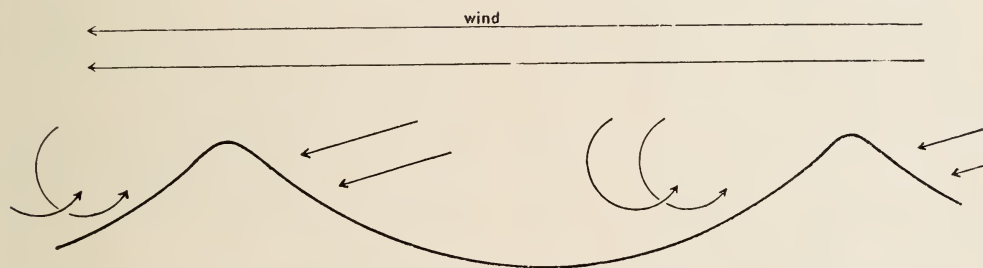


Fig. 10. Generation of water-waves by wind.

Moreover, when the wind is strong, it may tend to supply power to short waves to the extent of increasing their height above the limit ($\lambda/7$). The crests then break, giving "white horses." These are then seen on the shorter waves before the longer waves, which can absorb more power owing to their size and their greater rate of loss of energy by friction.

A further consequence is that, since there is a minimum velocity beneath which waves cannot travel, so there is a minimum wind velocity below which waves cannot be maintained. This minimum wind velocity is approximately 110 cm./sec., at which velocity a wavelength of approximately 8.8 cm. is maintained.

The length of the crest of a wave (measured at right-angles to its direction of motion) may vary considerably. There are both long-

crested and short-crested waves. A short-crested wave can be formed by the crossing of two convergent long-crested wave-trains. This is frequently seen in a pond when two trains of waves from stone-casts cross. Conversely, a short-crested wave generated by an impulse may resolve itself into two divergent long-crested waves. Thus the waves emanating from a storm centre may be long-crested although originating in a small confined area. Long-crested waves tend to predominate in a strong wind. In shallow water, greater power is required to maintain a given wave than in deep water.

This production of short-crested waves explains the formation of a mackerel sky, where two divergent wave-trains generated in the interface between a cloud layer and a thin layer of the adjacent air in motion break

up the cloud layer into a regular pattern of small patches.

In like manner waves are produced on the surface of wet sand which behaves as a fluid in contact with the moving sea.

Waves generated and maintained as described do not retain their regular pattern for long. Apart from the interference of other waves, any one wave tends to develop a train of waves which travel away from it forwards and backwards. The original wave also tends to change in length as it advances, thus also changing its velocity.

There is a property of wave-motion which must be considered, if we are to account for the existence of "swell" and the existence of waves in water over which the wind is not blowing, heralding as they may do, a storm. This is the property of group-velocity and its relation to phase-velocity.

“When an isolated group (train) of waves of sensibly the same length is advancing over relatively deep water, the velocity of the group as a whole is less than that of the individual waves composing it. If attention be fixed on a particular wave, it is seen to advance through the group, gradually dying out as it approaches the front, whilst its former place in the group is occupied in succession by other waves which have come forward from the rear.”

Henceforth, we will refer to the velocity of a single wave as V_λ and the velocity of the group as V_g . Then V_λ is known as the Phase Velocity and V_g as the Group Velocity. The significance of this distinction is that the wave-form travels with velocity V_λ and its energy content travels with velocity V_g . Phase velocity is double group velocity for gravity waves in deep water but as the depth is decreased, phase velocity approaches group velocity, thus :

$$\text{If } d > \lambda, V_\lambda = 2 V_g \dots\dots\dots(4)$$

$$\text{If } \frac{d}{\lambda} \rightarrow 0, V_\lambda \rightarrow V_g \dots\dots\dots(5)$$

For capillary waves, group velocity is greater than phase velocity, approaching in

the limit $3/2$ times phase velocity, thus :

$$\text{If } V_\lambda <, V_g \rightarrow \frac{3}{2} V_\lambda \dots\dots\dots(6)$$

Having made this distinction let us consider a storm centre moving across the sea. The velocity of the centre is the velocity at which the energy of the system moves, i.e. the group velocity. Individual waves will travel outwards at twice this velocity, and if sufficiently large will travel a considerable distance without the need for maintenance by wind. They may approach a shore in still air, thus indicating the approach of a storm. From their rate of arrival, we can measure their period. We can thus estimate their length (by an empirical relation) and hence their velocity. The storm is then advancing at half this velocity.

Waves which have travelled ahead of their parent “group” are termed “swell” and provide a disturbed surface on which fresh waves may be generated and maintained, probably at an angle to the swell.

Swell is a long-crested wave motion. The resultant swell which may be experienced at any point is produced by several swells from different sources, interfering and beating to give an irregular motion.

Table I gives some empirical values for wind and wave measurements at sea :

Table I

Beaufort No.	Wind m.p.h.	Waves m.p.h.	Period secs.	Length ft.	Height ft.	$\frac{\text{Length}}{\text{Height}}$
6½	31	24.8	7.0	251	21.7	11.6
7	35	28.0	8.0	328	24.7	13.3
8	42	33.6	9.6	472	29.4	16.0
9	50	40.0	11.4	666	35.0	19.0
10	59	47.2	13.5	934	41.3	22.6
11	68	54.2	15.5	1231	47.6	25.9
		= 8/10 of wind speed	= 2/7 of wind speed	= 5½ × (Period)²	= 7/10 of wind speed	= 1½ × period

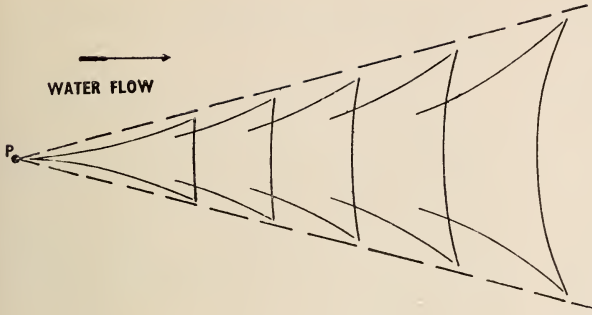


Fig. 11. Wave-pattern produced by water flowing past a stationary body.

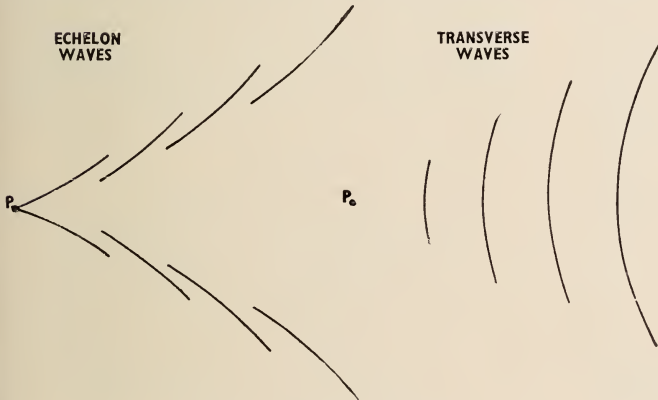


Fig. 12. Analysis of Fig. 11.

Ship Waves

Irrespective of any waves which may exist on the surface of a stretch of water, wave systems are produced by the passage of a floating body such as a ship. The system of waves produced by a ship is complex and can be divided into four separate wave-trains. Before defining these, we will establish the type of wave system produced by a small body moving through a fluid. The conditions are the same as obtain when the fluid moves past

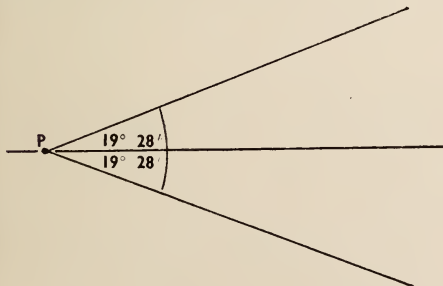


Fig. 13. Angle of envelope of Fig. 11.

a stationary body, e.g. a river flowing past a fishing line. In Fig. 11 is shown a small (point) body P partly immersed in a moving mass of water. The dotted lines in the figure mark the envelope of the wave system. In general, a pattern of waves established of the form shown remains stationary relative to the body, that is they travel on the surface at the same velocity as the body itself in the direction of its motion. This pattern is composed of two parts—two rows of echelon waves and a system of transverse waves, shown separately in Fig. 12.

This system is obtained when the velocity of the stream exceeds a certain minimum and when the water is deep. Under these conditions, the shape of the envelope remains constant at all speeds. The contained angle is twice $19^{\circ} 28'$ (see Fig. 13). Accordingly the length of the waves increases with increase of body speed. If the velocity between P and the water is

V_w and the velocity of the wave along the normal to its envelope is V_{λ} , then

$$V_{\lambda} = V_w \times \sin 19^{\circ} 28' \dots\dots\dots(7)$$

The velocity V_{λ} determines the value of λ . If V_{λ} falls below 23.2 cm./sec. the wave system cannot be maintained. Hence the lower limit for the velocity V_w is

$$\frac{23.2}{\sin 19^{\circ} 28'} = \frac{23.2}{1/3} = 69.6 \text{ cm./sec.} = 1.35 \text{ knots} \dots\dots(8)$$

The significance of this is that a model will

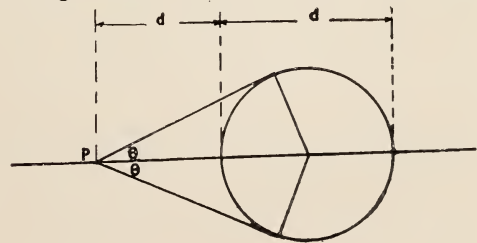


Fig. 14. Construction of angle shown in Fig. 13.

not give the correct wave pattern if travelling slower than 1.35 knots.

The geometrical construction for this envelope is as shown in Fig. 14.

$$\theta = \sin^{-1} \frac{1}{3} = \tan^{-1} \frac{1}{2\sqrt{2}}$$

The wave-train caused by P can be regarded as having a phase velocity of V_w . The group velocity is therefore $V_w/2$, i.e. half the apparent velocity, and when gravity waves are formed these spread out to the rear and the group follows the body at half its velocity. If the velocity of the body drops below the critical value 69.6 cm./sec. the echelon waves disappear leaving only the transverse waves. If it drops below 23.2 cm./sec., these also disappear and capillary waves are in evidence. Since their group velocity exceeds their phase velocity, the capillary wave-train extends in

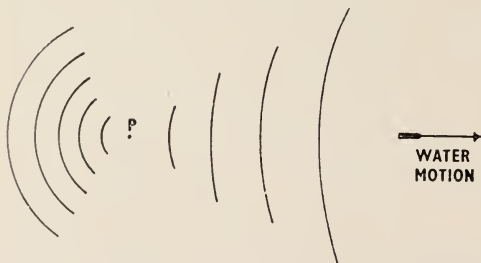


Fig. 15. Wave-system produced at low velocity.

front of the body. In an intermediate condition, we may have a system of capillary waves (of short length) extending forwards and a system of transverse waves (of greater length) extending backwards as in Fig. 15.

The passage of a partially immersed large body such as a ship, sets up a system at its bow, such as described above, and an additional similar system at its stern. The stern system, however, will be of the opposite phase to the bow system and the two systems may interfere or reinforce one another, depending on the size, shape and velocity of the ship. This causes an uneven increase in the resistance to motion of the ship as the velocity increases. Thus we have formed the two systems :

- (a) Oblique bow waves ;
- (b) Oblique stern waves.

We will next consider the remaining two systems :

- (c) Bow transverse waves ;
- (d) Stern transverse waves.

The latter two are distinct from the transverse components of (a) and (b).

Consider the passage of a ship through water. The water is deemed to flow past the ship in layers, known as stream-lines, shown in plan in Fig. 16.

When the flow becomes steady, it will be seen that the cross-section of the stream-lines at *b* is less than at *a* and *c*. Hence at *b*, the velocity of the water past the vessel must be greater than at *a* or *c*, decreasing as we move

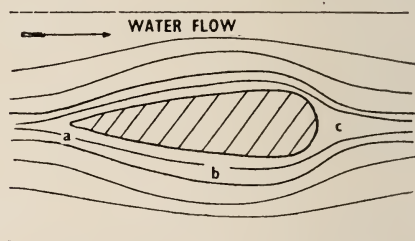


Fig. 16. Flow of water past a ship.

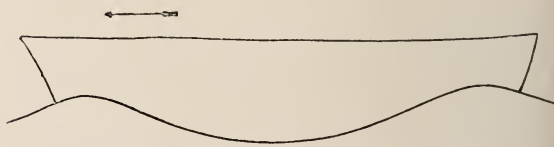


Fig. 17. Transverse waves produced by a ship in motion.

sideways away from the vessel. Hence at *b* the pressure must be less than at *a* or *c*. This uneven distribution of pressure along the length of a ship causes a depression of the water surface at *b* and an elevation at *a* and *c*, as shown in vertical section in Fig. 17.

This effect, though shown exaggerated, produces two transverse waves travelling at the same velocity as the ship. If the ship is long, each wave gives rise to a train which extends backwards. If the velocity of the ship is great, these may become so pronounced that the ship is raised above its normal level and the bow, especially if of shallow draught, may be brought clear of the water.

It should be realized that resistance to a ship's motion arises from the following three causes only :

- (1) Skin friction due to viscosity ;
- (2) Eddy resistance due to vorticity at the stern or behind any protrusion ;
- (3) Wave resistance, i.e. the loss of power in generating waves.

A wholly submerged body, such as a fish, contends with (1) and (2) only and these are minimized by the provision of a smooth skin and a lack of unnecessary protrusions.

When a ship passes into shallow water, different wave-systems may be produced. Consider again a point impulse moving relative to the surface in water of depth h , at a velocity c . Provided $c < \sqrt{g \cdot h}$, a train

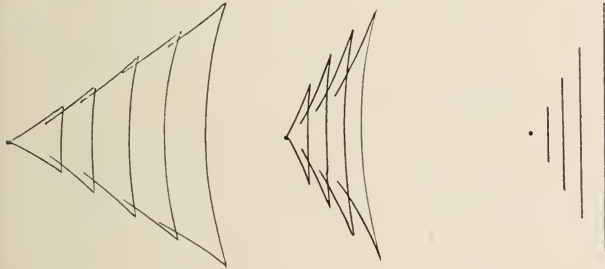


Fig. 18. Wave-system produced in shallow water.

will be generated as in Fig. 11. If the velocity is increased however, the lateral (echelon) waves become less oblique and when $c = \sqrt{g \cdot h}$ we have a critical condition in which the echelon waves disappear, leaving only the transverse waves (Fig. 18).

This last system is simpler than the previous system and results in a decrease in wave-resistance. Consequently a vessel in shallow water can attain a critical velocity at which the resistance to motion falls to a minimum before rising again with increased velocity. This fact has been utilised in the movement of barges in canals, to achieve this economical speed ; further increase in c results in the lateral wave system becoming oblique again but without echelon waves. The obliquity

is not constant (as in deep water) and can approach an angle zero as the velocity increases (Fig. 19). At the same time the shape of the waves has changed, these being concave to the ship.

As the depth is decreased the group velocity approaches the phase velocity, and the tendency to form a train of waves is reduced. The waves formed when $c = \sqrt{g \cdot h}$ are known as "long waves," because their length to height ratio is large and their slope gradual. The length of wave corresponding to a velocity $\sqrt{g \cdot h}$ is the longest free wave which can exist in water of depth h . Thus, when a vessel exceeds this velocity, the phase velocity must equal the velocity of the vessel but any train formed has a lesser velocity and cannot be maintained. So the system developed in Fig. 19 shows no train and the vessel travels on a single wave without forming any wash.

The wave-pattern formed in deep water tends to change to the less oblique form when $c = \frac{1}{2} \sqrt{g \cdot h}$ approximately. This provides a minimum value for h for any given c , if we wish to simulate deep-water

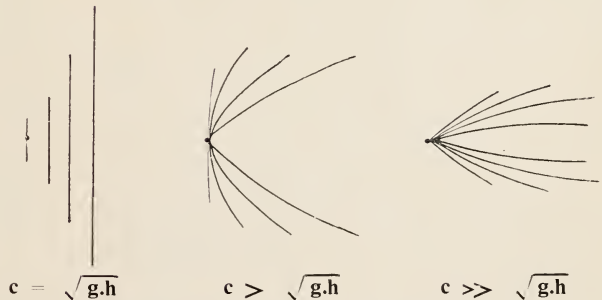


Fig. 19. Effect of increased velocity on the system shown in Fig. 18.

effects by means of models. The minimum depth should therefore be obtained from

$$c = \frac{1}{2} \sqrt{g \cdot h}$$

$$\text{i.e. } c^2 = \frac{1}{4} g \cdot h = 8 h \text{ (feet)}$$

$$h = \frac{c^2}{8} \text{ where } c \text{ is in ft./sec.....(9)}$$

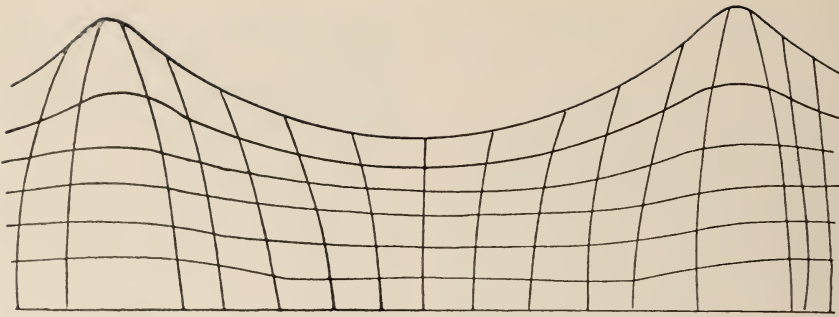


Fig. 20. Strain pattern of the cross-section of a water-wave.

Scale Effects

The general formula for the wave resistance of geometrically similar bodies similarly immersed is of the form (for deep water) :

$$R = \rho \cdot l^2 \cdot c^2 \cdot f\left(\frac{gl}{c^2}\right) \dots \dots \dots (10)$$

where l is the characteristic linear magnitude. R can be computed provided l/c^2 is constant. Thus, for a model ship to behave in water to the correct scale, c must be proportional to \sqrt{l} . This is expressed in Froude's first law :

Where two geometrically similarly bodies similarly immersed are behaving to scale in the same manner, then they are said to be travelling at "corresponding speeds." If the speed of the model is c and that of the real ship is C then :

$$\frac{C}{c} = \sqrt{\frac{L}{l}} \dots \dots \dots (11)$$

where L and l are the characteristic magnitudes (e.g. lengths).

L/l is the scale of the model, and this can be otherwise expressed that the factor for reducing the speed to suit the model is the square root of the scale.

Thus, employing a scale of 1 : 12, a speed of 13 knots should be reduced to

$$\frac{13}{\sqrt{12}} = \frac{13}{3.46} = \text{approximately 4 knots.}$$

Of course, the reduced speed is that required to provide a correct reproduction of wave-systems, pitching and rolling characteristics. The illusion will not be correct unless the apparent speed of the model can be reduced

by a further factor of $\sqrt{12}$ to give a correct linear reduction, e.g. in cinematography by increasing the camera speed by the factor $\sqrt{12}$.

Artificial Wave Production

There are two methods to consider. One is to direct artificial wind on to the surface of the water. The other is to use a mechanical wave-generator.

The requirements of a wave-generator are shown up by considering the motion required in the water to produce a wave on the surface (see Fig. 3). Another way of illustrating this is shown on Fig. 20, which shows the change in the shape of a series of planes (forming in still water a vertical and horizontal pattern) due to the passage of a wave.

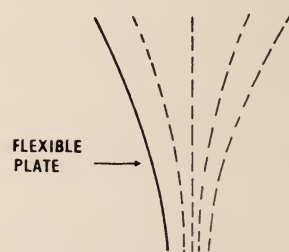


Fig. 21. Action of an ideal wave-maker.

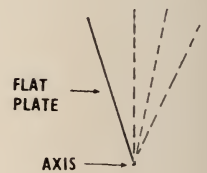


Fig. 22. Action of a practical wave-maker.

The effect of wave-motion would therefore be produced by the use of a flexible plate immersed in the water as shown in section in Fig. 21.

The dotted lines show successive positions of the plate and it will be seen that the plate must flex as it oscillates, and that its axis of

oscillation is at an infinite depth, since the wave motion decreases exponentially with depth (in Fig. 3, $a' = a.e^{-2\pi}$). This is the theoretically perfect form of a wave generator, but a close approximation can be obtained by a flat plate hinged about an axis at a depth of approximately λ , and oscillated about a vertical mean as in Fig. 22. Such a plate can be oscillated by an arm driven by a crank, which may be provided with a variable throw and a variable speed, to provide waves of variable height and length.

Such a wave generator will produce a train of waves on either side, the two trains being out of phase, and if it is situated close to the wall of a tank, the train of waves propagated towards the wall will be reflected and the reflected train will interfere with the other train. The unwanted train can however, be

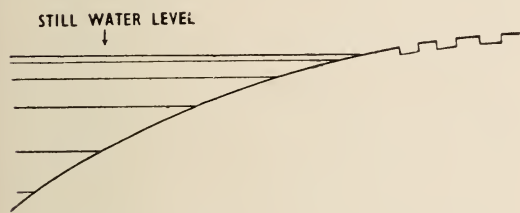


Fig. 23. Cross-section of an artificial beach.

destroyed by breaking them on an artificial beach situated at the rear of the wave-generator. An artificial beach consists of a sloping ramp terminating in a series of transverse channels which receive the water thrown up the beach and return it to the tank, as shown in section in Fig. 23.

Summary of Practical Conclusions

- i. Depth of tank should be at least $\frac{1}{4}$ the length of the longest wave to be produced artificially.

- ii. Waves must be produced with a minimum velocity of 0.45 knots.
- iii. Allowance should be made for "heave" set up by prolonged wave-making.
- iv. Wind used to maintain waves must have an adequate velocity to maintain the longest wave required. It must exceed 110 cm./sec.
- v. "White Horses" can be produced by a strong enough wind and will form on small waves before large ones.
- vi. Short-crested waves can be produced by converging different systems of long-crested waves.
- vii. A sea-surface should consist of systems of wind-maintained waves on a resultant swell which may be produced by wave-generators.
- viii. A model may be propelled at any speed in deep water above 69.6 cm./sec. (1.35 knots).
- ix. Depth of tank should be greater than one-eighth of the square of the maximum velocity at which a model will be propelled.
- x. The speed of a model should be the speed of the full size vessel, reduced by the square root of the scale. The camera speed should then be increased from normal by the square root of the scale.
- xi. A mechanical wave generator should be of the form described and hinged at as great a depth as possible.
- xii. An artificial beach should likewise be of the form described.

Acknowledgement

I wish to acknowledge the J. Arthur Rank Organisation for permission to reproduce these notes, which first appeared as a Studio Technical Advice Note in November, 1947.

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THE PRODUCTION OF TRAILERS

Esther Harris (Member) *

Read to a meeting of The Theatre Division on March 6, 1953

THE purpose of a trailer is to make a bad picture look good and a good one better. Trailer makers are simply publicists on film. If it is sometimes necessary to exaggerate it must be borne in mind that too much subtlety does not pay in mass selling to an audience of so many different degrees of understanding. It is necessary to be just a little larger than life as in most cases is the material which is being publicized. It is not easy to convey the greatness of the stars, the story and the scenes, without using superlatives, but we no longer use the "super colossal" adjectives which continue to be attributed to us. That does not mean that we no longer say that a picture is good, of course we do, but we say it more by inference than by over indulgence in superlatives.

We constantly try to be original in the presentation of trailers, even if we do not always succeed, but the most important point is that we must not be confusing; points must be made clearly and quickly in an average of two and a half minutes. The appeal must not only whet the appetites of the sophisticates of London's West End, but that very same trailer must persuade the patrons of the suburban and provincial cinemas to come and see the film too.

In nearly all cases, the trailers on American pictures come direct from America. A certain amount of Anglicizing, re-editing and sometimes re-making of American trailers is done to suit our market, but normally these American trailers are accepted as they come from the States. Any trailers on British pictures which are being distributed in the U.S.A. are sent to that country, but whereas we are happy enough to take their trailers with American idioms and narrators, America does not so easily take to our insular peculiarities. This isn't hard to understand when we

remember that we have been fed on American films for many years now and are not only used to hearing American voices, but many of us like them. Let us hope that one day the American public will react likewise to our product, be they trailers or films. The only major alterations made to British trailers, when they reach the other side, are to voices, rather than to words. One or two lines may be adjusted to sensationalize the sales angle but the shape of the trailer is nearly always acceptable to them. It is, however, mainly British trailers, made for British films, that I wish to discuss.

Preparation

Generally the film is seen at the Studio in its rough assembly, with an assistant who takes notes of the scenes that may be needed. A print of the picture with a sound track which consists only of dialogue is used, since at this stage the feature has not yet been dubbed with music and effects or furnished with opticals. If the feature is in Technicolor we similarly see such productions in the black-and-white print stage.

Choice of Scenes

We do not necessarily choose only those scenes which are the most exciting, whether from a romantic, dramatic or humorous point of view. All kinds of small and inconsequential shots are also taken from every reel and these are eventually welded together to become part of the trailer story.

For instance, in the case of a mystery story, any isolated shot which suggested mystery would be utilised, although in the feature there may be nothing mysterious about the shot at all. As an example, we would note shots of footsteps, or of a door being opened by an unseen hand; a telephone ringing;

* National Screen Service Ltd.

a light being switched on ; a shadow against a wall. Shots such as these, out of context, can be exceedingly useful to back a piece of narration or a title and to give the trailer a build-up of atmosphere. A chase, or any kind of fast action, is a wonderful aid to the general pace of the trailer. In fact, the more action the better, since a trailer must keep moving or have something equally arresting to grip the attention. If the scenes in themselves are slow and dull, then the presentation must be assisted by some extraneous build-up.

Preparation of Trailer Script

Having seen a film, a full trailer script is prepared. The shape of the trailer is decided at this stage. Some films are very much easier to sell than others ; so much depends on the material one has to work with.

Great consideration is given as how best to sell each particular picture. One goes on jostling with ideas and discarding them wholesale. One wonders whether the Stars are big enough ; are the scenes good enough in themselves to sell the seats ; how much padding do they need ? Does the Director mean anything to the public and is he worth emphasizing ? Is it a controversial subject, or should one make it so. Dare we sell it on sex, without making it nasty or running into Censor trouble ; or if it is a funny film, will the excerpts, divorced from their complete build-up, be funny enough ? And always, what is there *new* to say about the same old story ? The continuity of trailer scenes is not of great importance ; the highlights can be given away almost immediately so long as the effect is achieved. You can lead up to your climax by all means, but the cardinal sin is to give away the result of that climax. Leave it in the air. Never show what happens to the villain in the end. Let your hero and heroine quarrel like mad, but let your audience see next week the result of that quarrel. Keep them guessing. Make them want a little more. Leave them, like Pearl White, hanging on by their finger tips.

Invariably one tries to make the opening matter as arresting as possible, in fact, to do what a newspaper nearly always achieves

by its headlines, arrest the attention from the very first. You are then lured on to read the sub-headings and then to read the body of the article. Similarly, a trailer should start in the most arresting way so that the audience is forced to go on looking and listening to the next piece of information and the next—until the body of the trailer is established and the main advertising points have been put across.

Trailers are much larger than life and a little noisier too. We recognize the fact that they are wedged in between the popcorn rattling, seat tipping and ice-cream sales.

To add variety to trailer presentation the Stars are used whenever it is possible, and special scenes are shot. The script of the feature is often read immediately it is available, so that if an idea can be mapped out at that time, it is easier and certainly more economical to do the little shooting necessary whilst the film is still on the floor and the Stars are still under contract.

One tries to introduce new ideas in every conceivable way, in order to ring the changes on presentation, but many ideas which might work very well, may have to be discarded because of the time they would take to put over.

Once the idea has taken shape, a full trailer script is prepared for comment. Here, all the suggestions for dialogue scenes and material for backing titles and commentary are carefully explained and it is then ready for discussion by studio or distribution personnel, or both. The approval of a script varies very largely with the organisation. In some cases the studio takes the greater interest and sometimes the distributor.

Producers, directors, managing directors, sales and publicity directors are exceedingly alive to the value of a trailer, for it is generally conceded by those who should know, that the trailer is one of their most potent means of advertising.

The scripts, as they are submitted, are largely accepted but during the discussion stages there may emerge some suggestions regarding an additional scene—or a substitution—or both. A title or piece of

commentary may be rephrased, but most times the shape of the trailer, that is, its sales angle, is accepted.

The physical work on the trailer now begins. The scenes are ordered up around the script and we wait for the necessary materials to be delivered to us from the laboratory. The sorting out of material thereafter is a lengthy business although we are never exactly waiting for the material on the last picture we have seen as there are always many other trailers in production at the same time.

The final married feature prints are often viewed for the making of a trailer. This, of course, simplifies the Editor's job, but raises many technical problems. From a cutter's point of view, working on full takes is preferable to working on scenes taken from the cut negative, since with full takes, scenes can be telescoped to our heart's desire, and we can juggle much more effectively with music and effects.

Above all, however, time is the factor which decides the way we work. In most cases it is essential to work far ahead of the film's completion in order to meet the pre-releases which are often fixed whilst the first print is still drying in the laboratory; hence the general procedure of viewing the rough assembly of the picture before the feature negatives have been touched. It is the only way that coverage for West End and other early dates—and sometimes even general release dates—can be guaranteed.

Three examples of trailers were projected:

The first trailer, for Woman's Angle, was an example of special shooting, all the main Stars of the film in character role making their own introductions.

The second trailer was for Mississippi Gambler, made by National Screen America. Here, Tyrone Power introduced the story and the characters.

The third trailer was for Treasure Hunt, with Jimmy Edwards filmed for special introductory comments.

Material for the trailer takes some time to prepare at the laboratory and some of this time is used to put in hand the titles which

are to be superimposed over the scenes. The narration is meanwhile recorded, so that all the facilities for finally cutting together the trailer are available.

The title presentation and narrative used for trailers are exceedingly important and can, if they are wrong, mar a great deal of the trailer.

The manager of the art department is always presented with a script of a trailer and a discussion takes place as to the type of lettering required, and a rough layout of the titles is prepared.

Title Animation

Similarly, a script is handed to the camera room with specific instructions for title animation.

The placing of titles over scenes is given special attention and although sometimes complaints are made about titles covering the scenes too much, we are completely aware of this and do it with intention if we want the title read. Its backing is a scene which we do not mind you missing and is merely there to add atmosphere. We aim at a combined effect of title and background and are not interested in the single effect of either component. Where the picture must be seen clearly and the titles also, as in the case of portraits of Stars, the title is written at the bottom of the screen.

Narration

Where shots are interesting to look at, but would not in themselves be sufficient to hold your interest, such material would be utilised for narration. This leads to a very vital point in trailer making. The right kind of narration and the right kind of narrator play a very important part in a trailer and it is very difficult to find the most suitable man for the job. It is essential for a trailer narrator to know how to act with his voice. A straight news reader is usually of little use. A trailer commentator must be prepared to be melodramatic without, in fact, giving that impression. He has to get into the mood of the subject—and subsequently add to that mood. He must sell the film without forcing it on the public ear in an annoying manner.

Some quite insignificant shots in themselves, when joined together by good narration, can give atmosphere and mood to the whole trailer without titles covering up the action. A narrative also, is a first-class link for story points which need to be conveyed clearly and concisely. A narrative can do all the explaining in a few feet, that might otherwise take many scenes to put across ; but perhaps the most effective aid of all in trailer making is the use of music.

Nothing can so quickly destroy the mood and build-up of a trailer as an inadequate sound-track. An indifferent trailer can spring to life given good music, and a very good trailer can be dull and uninteresting because of a bad music track. Trailers, which are made up of so many bits and pieces from every part of the film in any kind of order, gain continuity by the use of music and effects. Trailer cutters spend a great deal of time laying music and are particularly adept in utilising the various chords and crescendos to point passages which need to be dramatized or accentuated. We often go right through the music of the whole feature to obtain particularly suitable bars and we also have an extensive music library of our own.

In laying music for a trailer, we seldom use less than eight separate tracks made up of innumerable small sections so that the cutters' cue sheets for the sound mixer are a positive work of art.

Censorship of Trailers

The censorship of trailers is a most interesting subject and is a surprisingly bothersome item in trailer production. Every trailer sent out must be prefaced with a "U" Certificate, no matter what category the film itself is given. Whether the film is "U," "A" or "X" we must still obtain from the British Board of Film Censors a "Universal" Certificate for its trailer. This is easy to understand when we remember that trailers are shown in every kind of mixed programme, to audiences of all ages. A trailer can be made to look "double X" although we do not purposely try to create a wrong impression at any time, just for the sake of it. The

Censor restrictions do, however, emasculate the trailer in many respects. We cannot make use of some of the most telling scenes from a film and this can be most frustrating. There are many censor restrictions which appear foolish, but which doubtless have good reasoning behind them.

Here are some examples of the things allowed and things frowned upon by the British Censor.

Generally speaking, the Censor does not like anyone being the target of any excessive violence. It is all right to fire a gun, but for the audience to see the bullet actually hit its target is seldom permissible. We must not show punching which is likely to distress children. For a man to slap a woman's face is taboo, although on the other hand, a woman may slap a man's face. Screams that curdle the blood are completely out. We have to play very carefully on divorce problems and the word "divorce" is not looked upon lightly, and wives being double-crossed by mistresses must be very delicately handled if at all. Risqué dialogue is definitely out, as are risqué scenes. Too much hip waggling is frowned upon and such words as "sin" and "shame" must be very carefully applied. There are, of course, many other Censor objections too numerous to itemize. As most films consist of some of these ingredients it is easy to imagine how difficult it is to make some trailers attractive to adult audiences.

America is allowed much more scope in the use of screen violence and there are consequently greater censorship problems with American trailers. The Breen Office and the British Board of Film Censors do not always see eye to eye on these matters.

To illustrate further these points some of the different types of trailers were shown.

The first was a trailer of the film of Cosh Boy, a film which has already raised a great deal of controversy. It was given an "X" Certificate, but the trailer, of course, had to merit a "U" Certificate. In spite of this the trailer was successful and also dynamic, largely because the subject matter was not only sensational, but also drew a moral.

The next was a trailer for Lost Property, a feature made in France and sub-titled in English. No dialogue or sub-titles were used, merely action and narration.

The next trailer, made in America for No Way Out was notable for the special use of mattes which were most effective.

The last trailer on this reel, for The Tales of Hoffmann, showed how to sell to the general public a picture not only unusual, but thought by some to be suitable only for special audiences.

Trailer Output

National Screen Service makes about 140 trailers a year, including several for American pictures which have not met the British distributor's requirements. The Production Department also handles six hundred American trailers, many being re-issues which need considerable re-editing to bring them up to date, and numerous changed titles which can be quite a worry.

Trailers which are made for the domestic market are eventually reproduced in many

other languages, using commentators who speak anything from Spanish-Portuguese to Urdu.

We also make what are called Teaser Trailers, which are usually made up of some very concentrated selling matter, either by way of press comment or by boosting some angle which maintains the general sales angle of the feature. Teaser Trailers are usually about half the length of the normal trailers and are shown one week ahead of the regular trailers.

Facilities Available

This production work uses a large camera room with two optical printers, two animation cameras and several other cameras, and seven of the best equipped cutting rooms in the country.

The Art Department has a large staff which not only writes titles, but also creates art backgrounds in both black and white and colour, for all kinds of subjects, apart from trailers.

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With colour so much to the fore, we are less self-sufficient; colour technique needs a longer period in trailer making and a colour trailer takes up to three months to complete whereas a black and white trailer can be finished in three to four weeks if necessary.

No trailer is serviced until the distributor of the film has given his approval and his assurance that scenes used in the trailer are excerpts from the feature. This, of course, does not cover scenes specially shot which the audience readily recognises as extraneous matter.

To illustrate the teaser trailers the one made for The African Queen was projected. It showed the manner of presentation of press comments, the use of several voices to add variety, and the reproduction of black and white press matter, with the colour backgrounds.

Two trailers in colour by Technicolor were projected, South of Algiers, an Associated British release, and Moulin Rouge, made for Romulus, as excellent examples of the modern trailer technique.

PERSONAL NEWS OF MEMBERS

Members are urged to keep fellow members conversant with their activities through the medium of BRITISH KINEMATOGRAPHY.

W. H. WILLIAMS (Member) has been appointed General Production Manager to the Film Producers' Guild, Ltd., and deputy to the Joint Managing Director of Merton Park Studios Ltd., and the Film Producers' Guild Ltd. A. C. SNOWDEN (Member) becomes the producer of entertainment films made for the Film Producers' Guild Ltd.

S. A. KERSHAW (Associate-Member) has been appointed the studio manager of Merton Park Studios Ltd. L. C. RUDKIN (Associate-Member) has taken his place as Assistant to the General Manager and Production Supervisor at Ealing Studios.

G. M. WOOLLER-JENNINGS (Member) has left Sound-Services, Ltd.

357 Minutes

of Screen Time — the output of a major studio — is the total of the footage produced during the past year by

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BRITISH KINEMATOGRAPHY

VOLUME 23 No. 5

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

NOVEMBER, 1953

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CURRENT THOUGHTS ON TELEVISION

It is to be expected that the Government's Memorandum on Television will provoke lively discussion throughout the film industry. The stage is set, both in the House of Lords and in the Commons, for a full scale debate, but it is feared that vested interests and ulterior motives are likely to obscure the basic policy of the Government. The policy is directed towards three objects; firstly, to introduce an element of competition into television and to enable private enterprise to play a full part in the development of this important and growing factor in our lives; secondly, to reduce to a minimum the financial commitments of the state; and thirdly, to proceed with caution into the new field, safeguarding this medium of entertainment and information from the risk of abuse or lowered cultural standards.

The relationship of television with the film industry is still in its early and formative stages, but already, in America, it is said that television entertainment in the home has so severely curtailed attendances at cinemas that many have been forced to close. In this country, notwithstanding the frequent televising of poor entertainment material, cinematograph exhibitors complain of the impact of television upon their box office receipts.

In considering the problems that have arisen in the U.S.A., and which may be repeated in this country in the near future, it is necessary to distinguish between the cinema owner and the film producer. In America, the cinema owner is no longer the film producer's only important customer. The annual expenditure on films specially produced for television purposes is, at present, rather more than \$22,000,000. This expenditure is rapidly increasing, because television is an omnivorous customer. There is a ready demand for all that the film studios can produce, and this demand

is limited only by the capacity of the sponsors or the broadcast companies to pay.

The televising of film programmes directly into the home offers a means of gaining a greatly increased revenue. The recent experiments conducted by the National Operations Research Centre of the University of Chicago indicate, perhaps, the future form of home entertainment. These tests were carried out in Chicago for a period of over three months. With the assistance of the Zenith Radio Corporation, scrambled images were broadcast and, by placing a dollar into a coin box, these were unscrambled by means of a synchronizing signal received over the telephone line. The results show that the public is prepared to pay for its film entertainment in the home. Families, from all financial levels, averaged nearly two performances a week to view films which were two or more years old. It is computed that, if one tenth of America's television owners paid one dollar per family for a single evening's entertainment, the revenue would be in the neighbourhood of \$2,000,000.

It costs Hollywood \$1,000,000 to produce a first rate entertainment film for television, lasting 90 minutes. If, therefore, a Hollywood producer offers a three-hour programme, he can recapture his investment on a single evening's showing, and even before the film is exhibited in the cinemas.

The Archbishop of York has said that television's influence in the future is incalculable. It may easily become the most powerful of all instruments in the formation of opinion and of national character. This statement is true, but we may rest assured that the British Film Industry will be fully alive to its responsibilities.

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LECTURE PROGRAMME — SPRING 1954

The meetings, excepting those on January 24 and February 24, will be held at the Gaumont-British Theatre Film House, Wardour Street, London, W.1, at 7.15 p.m.

SOCIETY MEETINGS

- January 6 ... "The Television Outside Broadcast Unit," by K. E. OWENS, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E., and P. R. BERKELEY, Grad.I.E.E.
(Joint meeting with the Television Society).
- February 3 ... "The Gevacolor Duplicating Process," by H. L. MEEUSSEN.
- March 3 ... "Stereophonic Sound Reproduction in Cinemas," by J. MOIR.

16mm. FILM DIVISION

- December 22 ... "Filming the Everest Expedition," by T. R. STOBART, B.Sc., F.R.G.S.
- January 26 ... 16mm. Film Evening.
- February 23 ... 16mm. Film Evening.
- March 10 ... "The Problems of Sound Reproduction," by F. H. BRITTAIN, D.F.H.

THEATRE DIVISION

- January 24 ... "Modern Cinema Equipment No. VI: Essoldomatic Apparatus," introduced by H. LAMBERT (Member).
To be held at the Essoldo Cinema, Kilburn High Road, London, N.W.6, at 10.45 a.m. for 11 a.m.
Admission by ticket only, obtainable in advance from the Secretary.
- March 31 ... "Current Developments in Film Presentation," by A. BOWEN, J. MOIR and F. A. TUCK (Member).

FILM PRODUCTION DIVISION

- January 20 ... "Producing 'Animal Farm'," by JOHN HALAS, JOY BATCHELOR and MATYAS SEIBER.
- February 17 ... "The Technical Aspects of Italian Film Production," by P. CAVAZZUTI (Member).

TELEVISION DIVISION

- January 27 ... "The Technique of Music for Television," by ERIC ROBINSON.
- February 24 ... "Micro Wave Transmissions to Cinemas," by T. M. C. LANCE, F.T.S. (Member).
To be held at 164 Shaftesbury Avenue, London, W.C.2, at 7.15 p.m.

THE PRACTICAL PROBLEMS OF 3-D PRESENTATION

G. E. Fielding (Member) *

Read to a meeting of the Theatre Division on October 4, 1953

THIS discussion will be on a practical note, omitting as far as possible reference to the purely technical side of the subject. To make sure however, that we are all thinking on the same lines the fundamentals of third dimensional photography and projection must be touched upon briefly.

3-D Fundamentals

In real life, we automatically perceive the third dimension, that is, that objects are solid and not flat, through the co-operation of several of our senses. The whole of these aids to perception of the third dimension cannot be simulated at the present state of the art of stereoscopic film ; but if good technique is used when the film is produced and if meticulous care is taken in projection, then the results achieved can be commercially successful without undue strain upon the patron.

There are several methods of obtaining stereoscopic films, some of them only in the laboratory stage as yet. They all have one aim, to present one picture to the left eye and a different picture to the right eye of the observer.

Whilst a person with monocular vision can develop the perception of distance through the necessity to refocus, he cannot fully compensate for the loss of one eye since the main factor which gives the third dimensional effect is the reception by the brain of two separate images from two separate points of view. By presenting these two separate pictures to a patron in a cinema, we can obtain a very good impression of a third dimension, of solidity.

Conditions to be fulfilled

The principal method at present adopted is to use two films, one representing a left eye

view and the other a right eye view. The films are projected synchronously, with equipment so arranged as to present, superimposed, two separate pictures to each patron. This is achieved by polarising the light from the two projectors in different planes and providing the patron with viewers to prevent the left eye from seeing the right eye picture and the right eye from seeing the left eye picture. Briefly the conditions to be fulfilled are :—

- (1) That two prints are provided, one right eye and one left eye view.
- (2) That they are projected synchronously, superimposed one upon the other.
- (3) That the patron is able to segregate these pictures so that his left eye sees the left eye picture only and his right eye sees the right eye picture only.

Interlocks

To run the prints synchronously it is necessary, until double headed projectors become commercially available, to interlock existing machines either electrically or mechanically. Both methods have proved quite satisfactory in operation provided the inherent design is good.

In the case of the selsyn type of interlock, it is essential that the selsyn motors used shall be of adequate rating and shall not run near their synchronous speed, otherwise, the torque developed may be insufficient and it may be possible for the two films to get out of synchronism.

The two selsyn motors, one on each projector, are mechanically locked to their respective projector motors and are coupled electrically in such a manner that when the rotor of one is moved, the rotor of the other follows it in the same direction and exactly the same amount, so that whatever happens

* Associated British Cinemas, Ltd.

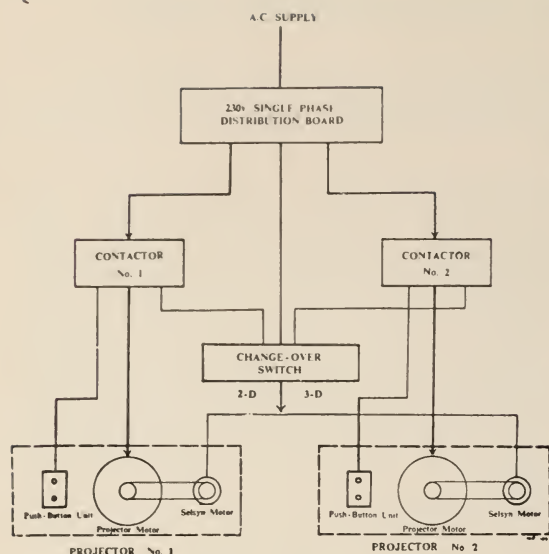
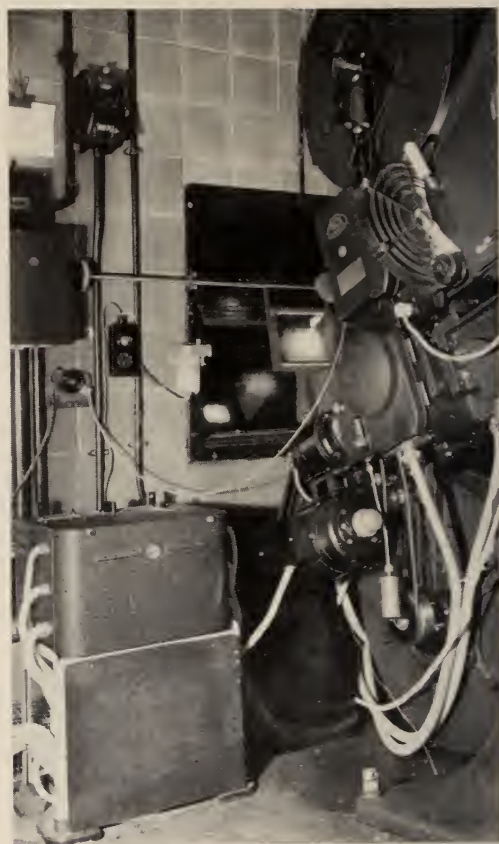


Fig. 1 (above). Circuit diagram of selsyn interlock equipment.

Fig. 2 (right). Portable selsyn interlock equipment fitted to a projector. The filter is shown mounted, and in the foreground is the control gear incorporating the 2-D 3-D switch.



to one machine is automatically reproduced immediately in the other machine.

In the case of the mechanical interlock, in order to reduce wear and vibration to a minimum and simplify maintenance, the coupling should be made between the two projectors at a point where the speed of rotation will be relatively low. Each combination of soundhead and projector presents its individual problem from an interlocking point of view, but there are available on the market, suitably designed interlocks both selsyn and mechanical for all of the possible combinations of projection equipment with the exception of the really obsolete types.

Spool-boxes and Spools

Since most theatres are not luxuriously equipped with four projectors, it is necessary when projecting feature films, to have intermissions for rethreading ; and to keep such

intermissions to a minimum, it is preferable to install large spool-boxes capable of taking spools of 22-inch or 23-inch diameter, which, in the case of most feature films, will make only one intermission necessary. A spool loaded with more than four thousand feet of film weighs approximately a quarter of a hundredweight, and the take-up mechanisms must ensure that take-up is effective over the whole range from an empty spool to a full spool.

In the United States, an attempt has been made to lessen the difficulty by the use of light-weight spools with free-wheeling cheeks, the hub revolving independently of the sides of the spool. In practice, this is quite effective. In this country, one development has been the use of a modified design of the take-up mechanism which can be set to give the same tension on the film irrespective of whether the spool is empty or nearly full and even during

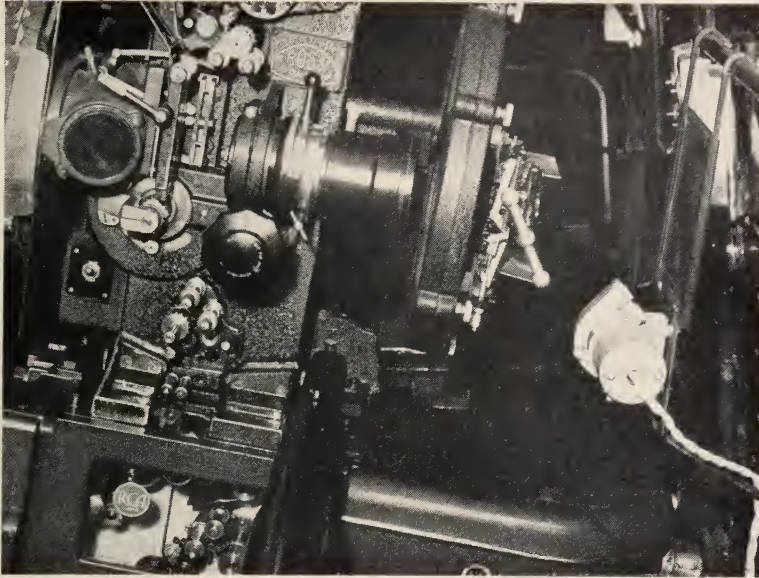


Fig. 3. The mechanical interlock fitted to a projector. On the right is a filter holder, filter and blower.

a snatch start. This seems most effective in practice.

Rewinders.

The use of large 22-inch or 23-inch spools necessitates modification to the rewinders. For most types of rewriter, the inexpensive method is to raise the two elements of the rewriter on hardwood blocks so that the new size spools can be accommodated. Where the rewriter has a bedplate which would foul the large type spool, there is no alternative but to purchase new rewinders.

Rewiring Projector Motors

The projector motors must be rewired not only to operate synchronously when interlocked but individually when required for 2-D films. In the case of the electrical selsyn interlock, this will automatically be provided in the normal wiring of the selsyn equipment.

In the case of the mechanical interlock it should not be possible for one motor only to be switched on when the mechanical interlock clutches are in the interlock position, as an attempt to run up two projectors by one motor will almost certainly result in stripped gears. Care must be taken also to ensure that

the fusing or other overload protection is modified by the switchover device to be suitable for each type of operation.

Arc Lamps

It is essential that the arc lamps are in first-class condition. If the screen luminance with a matt white screen is near the top limit of the B.S.I. specification, then with a good metallic screen, a reasonable 3-D picture will be obtained ; but if the screen luminance is low, either new arc lamps must be installed or the efficiency of the existing arc lamps must be increased.

A substantial amount of light is lost in transmission through the polarizing filter and in the patrons' viewers ; the gain in light brought about by the use of a metallized screen does not compensate completely for these losses.

Increasing the burning rate of a given trim above its normal rate will not solve the problem for two reasons ; the burning rate of the carbons will increase to such an extent that it is improbable that they will last for a full 4,500 or 5,000 ft. reel, and the positive crater will not be as stable as it would be at the normal burning rate for the trim and severe spindling may well occur.

It is important to have stable arcs, as one of the most annoying faults with 3-D projection is inequality of light from the two arc lamps ; it gives the patron an irritating feeling that his viewers need cleaning and his first impulse is to take off his viewers and wipe one side with his handkerchief. It is a relatively simple matter to interlock projectors compared with the problem of interlocking projectionists so that they put two equally lighted pictures on to the screen, an extremely difficult job.

Arc Traverse

A check should next be made of the carbon burning rate at the amperage necessary to obtain a satisfactory 3-D picture. Many modern arcs have a long enough traverse to give the requisite 55 minutes with a slight margin for safety, but many recently installed lamps will be found lacking in this respect and enquiries should be made of the manufacturers whether a conversion kit is available to rectify this defect. If such a kit is not available, there is no alternative but to install new lamps or accept more than one intermission during the feature film.

Arc Supply

Having decided on the trim and the burning rate, the arc supply must be checked to ascertain whether it will run two arcs continuously at possibly a higher current than hitherto. In the case of motor generator sets or bulk supply rectifiers where one large rectifier supplies both arc lamps, it is relatively simple to determine whether the continuously rated output of the supply unit is enough to deal with the new conditions.

In the case of individual rectifying units it is not so easy to determine this fact without the help of the manufacturer because many of the units were designed on an intermittent rating based upon a twenty-minute cycle of operation. If these units are run continuously with a maximum of five minutes break for rethreading after a fifty minute run, they may overheat and cause a transformer burn-out, or a burnout of the stacks in the case of the dry plate type of rectifier. In the case

of such units therefore, and especially those which are designed to be fitted in the projection room under the arc lamp, the manufacturer should be consulted. Where individual rectifiers have been installed remote from the projection room, much can be done by means of forced ventilation to increase the rating to cope with the new conditions.

Polarizing Filters

Each projector must be provided with a polarizing filter. At the present moment, the Nicol prism can be ruled out on the score of expense and scarcity although such a filter may be available in the not too distant future. It would have many advantages in that it would stand considerable heat and would be more stable under projection conditions than the type of filter used at present.

The normal polarizing filter may be sandwiched between two sheets of optical glass or laminations of plastic. The small glass type filter may be more efficient but suffers from the disadvantage of the tendency to build up heat within the relatively thick glass plates. The plastic type of filter can be cooled very much more easily since its relative thinness enables the heat to be dissipated more rapidly.

The filter should be so situated that the light beam is spread over as great a surface as possible and it must be exactly at right angles to the axis of the projection beam. It is also important that the filters are installed in correct vertical or horizontal positions to match the viewers worn by the patrons.

An adequate forced draught must be available for cooling purposes, but since this is standard practice in projection rooms for the cooling of colour media, this should not prove difficult for any average projectionist to install.

Screen

Turning now to the screen end of the operation, the screen must be a series of compromises ; it must not be a mirror surface which would simply give patrons a view of the projection lens and rear of the auditorium

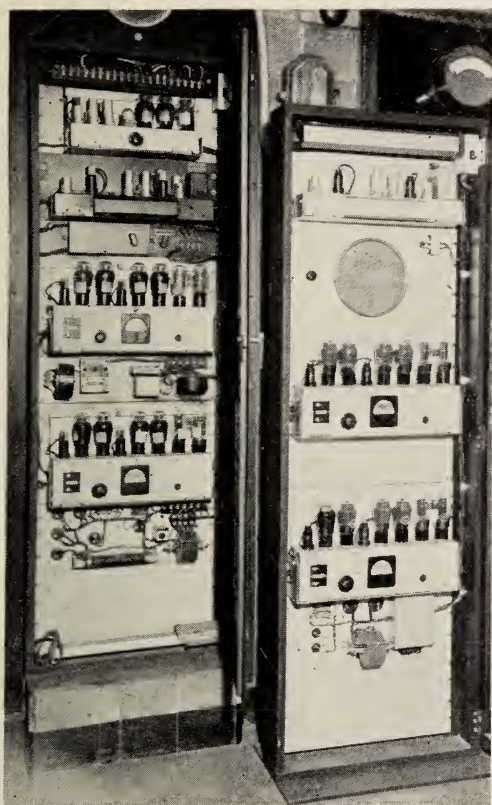


Fig. 4. *Special auditorium sound effects amplifier, coupled to the normal amplifier.*

and it must not be a completely matt diffusing screen as this would almost completely depolarize the light which we have taken so much care to polarize. This compromise is best achieved by using a metallic surface such as is given by aluminium paint sprayed on in the correct manner. Again we are confronted by two conflicting factors. The greatest possible gain in light is needed to compensate for the loss of light in the filters and viewers, but at the same time we require the best possible distribution over the auditorium both horizontally and vertically without reaching the point where the screen is diffusive.

These two factors are completely incompatible and a compromise has to be made. Some of the "hotness" of the screen must be sacrificed to obtain distribution. Whilst this

falls naturally within the province of the screen manufacturers, it has a great bearing on the number of seats from which true stereoscopic vision may be obtained and in some auditoria it may be necessary to rule out certain side seats as unsuitable for use when a 3-D film is being shown.

Light Distribution

Each auditorium has its particular problems and no hard and fast ruling can be laid down as to how much a screen should be raked backwards to obtain stereoscopic vision both in the front stalls and the back circle. Practical experience over a large number of theatres is gradually giving an indication of what this angle should be, but there are some auditoria which cannot be classed as within the average cross section, which will have to be treated individually.

In some auditoria it may be necessary to sacrifice part of the seating area, not so much because of the fall off in luminance from the screen as that seats in certain positions may receive depolarized light which will not give a stereoscopic view to the patron.

Viewers

Viewers pose a greater problem to the commercial or management side of the industry than to the technical side. Since the throwaway type is very little used in this country, consider the permanent type of viewer only.

Its coverage as far as the angle of vision is concerned should be adequate but should not be too great unless it is specially designed or it will pick up considerable extraneous reflection from the maintained lighting at the rear of the patron. This is a particularly irritating form of interference.

Viewers should be checked for correct polarization and the actual filters should have complete freedom from buckle and from scratches. If they are buckled in any way, the result is akin to that experienced when looking through cheap window glass which gives rise to an unpleasant form of distortion. The viewer filters should also be checked to make sure that the plastic laminations are

not prone to opening up and allowing the filter medium to move out of true polarization position.

Finally, whilst it is not technically necessary, it is a decided advantage to have them made in such a manner that, whilst they are quite comfortable, they cannot easily be folded up and put into the pocket.

Trailers

To complete the theatre equipment, it is highly desirable to have a set of slides or trailers made to show at the appropriate parts of the programme to announce to patrons when they should use their viewers and to indicate that they should be returned to the collectors on leaving the theatre.

Lining Up—General Operation

Having equipped the theatre, the first practical job is to line up the projectors on to the screen. For this purpose, various line-up charts are available and lengths of such film may be made up into loops for continuous running whilst lining up is carried out. It is impossible to line up the pictures from both projectors except at one point, but for practical purposes it is possible to obtain a reasonable line up over the whole of the screen area.

An endeavour should be made to get the centre of the pictures perfectly lined up and superimposed and then to get the best results possible over the rest of the screen. If this cannot be achieved, a check should be made to determine whether one picture is appreciably larger than the other. If this be so, the lenses are not a sufficiently near match to provide satisfactory 3-D operation and a pair of more closely matched lenses will be required.

Incidentally, in carrying out this operation, a long enough loop should be used in each case for the film to take up its natural running position in the gate, and only sufficient light should be used to give a clear indication for matching purposes. With a full high intensity arc, the line up charts will tend to shrink and will almost certainly shrink unevenly on the two loops making it impossible to obtain a really satisfactory line up.

It is a good plan too, after the projectors have been lined up, to change over the loops and check again. If the line up is not as good as previously, then the loops are not themselves satisfactory for the purpose. It has been found from practical experience, that it is quite possible with good line up loops, to line up the projectors, change over the loops and register the same accuracy of line up. In this connection, until the projectors have settled down, it may be found necessary to check the line up each day before commencing the programme.

Rehearsal

Except in the most unusual circumstances, such as the last minute arrival of the programme, it is important to rehearse the picture before showing it to the public, as it has been found from experience that there is a possibility that it may be out of synchronization. If by any chance the film is out of synchronization when received, it is a very tedious job to rectify the defect by a foot by foot examination of both prints.

The distance between footage marks has to be compared foot by foot until the discrepancy is found and the requisite amount of black leader must be inserted in the film which is short to bring it up to the correct length to synchronize with the second component.

Projection Racks, Light and Focus

3-D films can be made or marred completely by projection. The best opportunity of lining up the two films vertically is when the titles first appear. Titles give a very positive means of lining up when viewed without viewers. Do not be misled into trying to line up on the Censor's Certificate as in most cases it is completely out of line.

Throughout the showing of the film, the most important points to watch are the equal intensity of the arcs, the correction of racks which may occur even with the best of prints and the maintenance of correct focus on both machines.

Checking for vertical line up or racks can of course only be carried out without viewers and it must be arranged beforehand between

the two projectionists, as to which man shall carry out correction, otherwise, both can make an attempt at the same time with disastrous results.

Equal intensity from the arcs can only be maintained by periodically looking at the picture with a normal pair of viewers to check that the results appear the same to both eyes.

Correct focus is best done by using a pair of viewers which contain two left eye or two right eye filters according to which projector is being checked.

To do this job correctly therefore, each projectionist must periodically view the film without viewers, with normal viewers and with the special twin left or twin right viewers.

Resynchronization

If synchronization is lost during projection, experience at present indicates that there is only one safe way of regaining it and that is to close down and resynchronize the films by pulling them through to the start of the first picture of the next scene where the two prints can again be positively synchronized.

Operating Procedure

Assuming that the prints to be played have been examined on the rewind bench and that the standard leaders are in synchronization, a definite procedure for synchronizing and lacing up should be rigidly adhered to.

If the selsyn type interlock is fitted, the selsyn motors themselves normally have a mark on the inching knobs or shafts which must both be set into similar positions before switching to 3-D. It is as well, once these marks have been synchronized, to check the shutter blades to ensure that they are both in similar positions.

Once the synchronizing switch is in the "ON" position, the projectors should be turned over by hand so that the intermittent movements are in a locked position with both shutters vertical.

For those equipments fitted with mechanical interlocks, the first thing to do is to throw the electrical inter-coupling switch into the 3-D position, and then the clutches can be

engaged and both machines turned over by hand to ensure that the clutch engagement is correct, that is, that both intermittent movements are pulling down at precisely the same time.

It is found in practice, that two operators are required to lace or load their respective projectors. Once the reel has been placed in the top spool-box, the two projectionists should agree between themselves a start mark to be located in the aperture.

When the lacing up has been completed, it is advisable for the projectionists to cross over and check each others' machines.

It has been found advisable for the senior projectionist to operate the left hand or No. 1 machine, and it is his responsibility to start the programme.

As mentioned earlier, the framing of both pictures must be kept perfectly in alignment, therefore, as soon as the show commences, the No. 1 projectionist's first operation is to check without wearing viewers for framing alignment. During this time, the right hand operator, by using the special twin right viewers or by using normal viewers and closing his left eye, is checking his picture for focus and screen illumination. Immediately the No. 1 or left hand projectionist is satisfied that framing is correct, he dons his viewers and similarly, checks for focus and screen brilliance for his machine. Perfect presentation is then purely a question of keeping both projectors matched in screen illumination, focus and frame alignment.

Normal 3-D prints have composite sound tracks on both left and right eye prints and it is advisable to use the sound track from the left eye print under the control of the left hand or senior projectionist.

The provision of special storage cabinets to accommodate large spools of film has not been mentioned because, whilst 5000 ft. spools continue to be the exception rather than the rule, it is quite convenient to keep them when not in use, in the film transit case. Such spools loaded with film should not be dropped into the case; with a quarter hundredweight of film spooled up, the spools would buckle under the weight. The transit

case should be laid down on its narrow edge and the spool should be rolled into it.

Check of Polarizing Filters

Polarizing filters should be checked prior to every performance for efficiency of polarization. This can be done by holding them superimposed in front of a reasonably bright light, and checking that over the whole surface, practically no light is transmitted. Should there be patches where light is being transmitted, then a check of the old filters against new filters will quickly indicate which of the existing filters is defective. The criterion is the amount of break-through experienced whilst the picture is being projected on the screen.

This can be checked with new filters by projecting one picture only, say the left eye print and viewing it with the right eye viewer and noting how much of the picture can be seen. This can be repeated using the right eye print and the left eye viewer. There is bound to be a small amount of break-through and if a lengthy run exceeding a week is taking place, a periodical check will indicate any increase in the amount of break-through; when this becomes noticeable, the filters should be changed.

A quick indication can be obtained by viewing, from the front stalls, the projection beams where they leave the portholes. If polarization is efficient, closing the right eye will cancel out the right eye picture beam and closing the left eye will cancel out the left eye picture beam.

Under no circumstances should white light direct from the arc without running film be projected through the polarizing filters. The polarizing medium is unstable under the influence of the amount of heat absorbed under this condition and a few seconds is sufficient to render any filter virtually useless.

Cleaning of Polarizing Filters

Care should be taken not to handle filters other than by the edges as perspiration and grease from the skin is extremely difficult to remove. Filters should be cleaned carefully before each performance. This must be done very slowly with a moist leather or the surface

of the filter will be given an electrostatic charge which will attract minute particles floating in the air. Brushes containing radio active isotopes are apparently not available in this country as yet, otherwise, this cleaning procedure would be simplified.

Maintenance of Viewers

Viewers must also be sterilized and maintained between each use. They should be checked for correct polarization, any loose filters should be tightened or reset, and scratched or defective viewers which have slight pinholes of non-polarization should be rejected.

There are disinfectant manufacturers who are prepared to issue complete instructions for sterilizing viewers and supply the necessary fluid, with an indemnity against any action which may be taken by patrons, provided their sterilization instructions have been carried out satisfactorily.

Maintenance of Projectors

The general maintenance of projectors used for 3-D projection must definitely be more stringent than for normal projection. The slightest weave or jump or general unsteadiness of picture can cause very severe eye-strain and the amount of movement which can be tolerated for normal flat projection is far too great for 3-D operation. This means that defective parts, and particularly sprockets and gate parts, will have to be replaced at more frequent intervals than has been usual.

Maintenance of Screen

Ultimately the screen will need attention but until more experience is gained in this direction no specific recommendations can be given. There is no doubt that the necessity in most cases for raking screens backwards, will accelerate the collection of dust which incidentally, should not be *brushed* off.

Conclusion

Projectionists who have not had experience with 3-D films will realize that successful presentation does not call for exceptional genius but it does require meticulous attention to every detail to ensure a good performance.

DISCUSSION

W. GOLDSTEIN : Many people have defective eyesight, are they able to see 3-D ?

THE AUTHOR : I suffer from defective eyesight, but can see 3-D as well as other people. There is no difficulty in wearing viewers over ordinary glasses. Anyone with defective eyesight in which one eye is much weaker than the other and is not corrected by glasses or contact lenses cannot see 3-D as we know it.

A VISITOR : How do twin projectors get out of synchronization and what is the out of sync. tolerance allowed ?

THE AUTHOR : It may be due to failure of the electrical interlock if the selsyn motor is not adequately rated. With mechanical interlock the " dogs " may become disengaged. With regard to the tolerance allowed, pending further experiments I should say not more than a complete frame.

A MEMBER : Would it be possible to ensure that the prints are both correct when received from the renter ?

THE AUTHOR : It should be remembered that 3-D is in its infancy. The renter at this stage cannot always be perfect, and the projectionist must be prepared to receive a little trouble.

D. DAVIS : Is it better to insert blank film rather than to cut from the other copy ?

THE AUTHOR : When black leader is inserted the patron feels blind in one eye, therefore long lengths of this leader are inadvisable. If used for small defects, one or two frames, it is preferable, since the sound track remains uncut on one print.

A. E. ELLIS : It should be made clear that the renter would not like 15 feet of film to be cut from the other print. I should recommend that where one frame is in question the best plan is to remove the identical frame from the other print, you then have only one join instead of two, where 6 to 7 frames are in question then insert black leader.

J. PARKER : Does a curved wide screen have a detrimental effect on polarizing ?

THE AUTHOR : The curvature is so small that it will not affect polarization to an appreciable extent.

S. A. STEVENS : I would suggest that a steep projection rake has a greater adverse effect than the curvature of a wide screen.

THE AUTHOR : The projection rake is certainly more critical, but I have had no case where seats have been sacrificed because of the rake affecting polarization.

M. K. McLOUGHLIN : With regard to shutter phasing, I have had experience where one projector was out of phase and the other in phase. There was no noticeable effect when out of phase.

A VISITOR : Would it not be advisable to provide the projectionist with adjustable spectacles ?

THE AUTHOR : I have seen a prototype spectacle, with one filter permanent and one able to be rotated through 90° to turn it into a left eye filter. I would

not like to trust patrons with glasses of this description but they are most suitable for projectionists.

A. JAYE : Is it necessary to rewind both reels in synchronization and is it permitted to have power rewind machines ?

THE AUTHOR : It is not necessary to rewind in synchronization. Power rewinds are allowed for in projection rooms and certainly this has been taken into account in the new Home Office Regulations.

A MEMBER : What happens with light and dark copies ?

THE AUTHOR : That is a definite hint to processing laboratories to supply prints of matched density. In such cases the patron would get the feeling that one filter needed cleaning.

A VISITOR : What is the procedure if a dry join comes apart in the spool box ?

THE AUTHOR : If there is some time to run, shut down the projectors, re-synchronize, and start up again.

A VISITOR : Does an auditorium full of smoke or fog affect the polarizing ?

THE AUTHOR : I have had no experience in this connection, but would suggest that it does not make very much difference.

A MEMBER : What action should be taken if one copy is scratched ?

THE AUTHOR : It should be decided whether it is bad enough to consult the renter.

M. K. McLOUGHLIN : Wouldn't it be better to pull down to the nearest index number, rather than the start of the next scene ?

THE AUTHOR : In theory it is possible, but from experience there are difficulties. On some prints the index numbers are fuzzy, and on other prints there are no marks for sometimes 100 feet. That is why it is recommended to pull down to the next scene.

A MEMBER : If one filter is defective, is it advisable to put in a new pair or just replace one ?

THE AUTHOR : If the defect is due to deterioration, it is advisable to replace the pair, but if due to an accident one should be sufficient.

A MEMBER : I recently saw *Sangree*, and when I raised my spectacles on some parts of the screen there were two images and on other parts only one.

THE AUTHOR : That is quite the natural order of things. The foreground was probably intended to be approximately where the screen was in the theatre, and would appear as 2-D. The background images were intended to give depth to the picture.

A MEMBER : What is the effect if the laboratories overprint on one part of the copy ?

THE AUTHOR : It would obviously impose eyestrain. The tolerances will have to be very strict.

A VISITOR : If there is trouble during the last few minutes of the running time, would it be best to finish the film as a 2-D ?

THE AUTHOR : Discretion is needed. If only a few minutes were left it would be the best plan to adopt.

2-D AND 3-D TRENDS IN THE CURRENT CINEMA

R. J. Spottiswoode, M.A. (Member) *

Read to a meeting of The British Kinematograph Society on October 7, 1953

THERE is a legend which the motion picture industry has carefully cultivated over many years ; that films are the result of advanced and unremitting research by the studios in their pursuit of technical perfection. This myth has, I suppose, deceived much of the industry itself, and it has, of course, completely taken in the public. But if we compare the technological achievements of the film industry with, for example, advances in gas turbines or antibiotics, we shall find that the movies can take little credit for their accomplishments.

Between 1889, when Eastman and Edison laid down the 35mm. perforation gauge, and the beginning of 1953, there was only one revolutionary change in film—the coming of sound. That development and the perfection of colour were the work of large corporations having nothing to do with the production side of the industry, which merely called the tune and afterwards reaped the reward. Contented to do this, the producers ignored the fact that their medium was growing or at least changing without a plan, and that a serious economic crisis would reduce it to chaos. Nor is this in any way surprising, when we consider how the attitude of this industry towards basic research and controlled experiment differs from that of other industries of comparable size. Pooled industrial research has become widespread in recent years, especially in Great Britain. Industries with a membership of half a dozen firms, or as many as several hundred, subscribe to the setting up of joint facilities which are applied both to individual and to common problems. In America, where joint research is not so much the rule, industrial corporations spend a much higher proportion of their earnings on basic development than is the case in England. In both countries it is realized that technical

advance is essential to survival, and that the bigger the industrial unit the more it pays to pour resources into fundamental research.

Against this picture the film industry presents the poorest of comparisons. Though it is the producers who stand to reap the great speculative rewards of the industry, and must incur the largest losses if they are overwhelmed by competition from outside, they disregard the technical means which underpin their whole position in a major industry.

The arrival of sound on synchronized disc and film, though no great technical earthquake since it had been the subject of development outside the film industry for more than a decade, rent that industry with bankruptcy and reorganization and caused millions of dollars of investors' money to be lost. As a result, Hollywood belatedly set up the Motion Picture Research Council, a very small organization which, though admirably staffed, is pitifully under-financed to deal with the problems which have arisen in this year of technical crisis, and is besides hampered by the bitter competition which rages between the different studios.

In this country there is not even a small joint organization to carry forward film research. Shortly after the war the J. Arthur Rank Group set up a research unit on lines which gave some promise of future progress ; but for reasons not germane to this paper it was soon whittled away and virtually abandoned, although during its short life it had fathered (besides one conspicuous failure) a very successful development of the travelling matte process. When the industry was faced this year with radical alterations to its technical structure—both in respect of picture and sound—the B.K.S. took the lead in applying for a relatively small sum from the Eady Fund for the investigation of the new

* Stereo Techniques Limited.

techniques. Modest as this proposal is, it has been turned down temporarily at least, by the British Film Producers Association ; and while it would be improper to comment further on a subject which is still under discussion, it is permissible to suggest that even if the proposal were accepted, it would barely scratch the surface of what needs to be done.

The film equipment industry in this country is not much less backward than, on the technical side, are the producers without whom many of them would not be in business. Some of these manufacturers are engaged in making "Chinese copies" of American equipment ; others follow the American lead under licence and produce to specification what has been originated and developed across the Atlantic ; and where an original idea, be it in camera, screen, or editing equipment design, is actually fathered over here, its sponsors will have the greatest difficulty in getting it accepted by producers who innately distrust the home article.

It is against this background of an industry which can scarcely be persuaded to look beyond the next picture that I wish to set the technical crisis of the present year. It was on September 30, 1952, that the first of the great innovations, Cinerama, was presented to a wildly excited public in New York, and one year later it was still running the same film in the same theatre. Cinerama was the invention of Fred Waller, who had designed a 16mm. gunnery trainer during the war. Great as was the impact of Cinerama on New York audiences, it aroused little excitement in Hollywood, as I know from personal experience, and this principally because Cinerama had found its backing in the East, and everyone on the West Coast agrees that no other part of America knows anything about making movies ! The revolution brewing in their midst left the producers completely undisturbed. For at this very time, another outsider, Milton Gunzburg, was preparing the first American 3-D feature film.

Parenthetically it should be said that the prior development of 3-D and its viewing by the modern polarized method had also been ignored by the film studios. It owed its

origin to the Polaroid Corporation, a supplier of material for scientific instruments and for sunglasses, and to the energy of John Norling, a New York producer of documentary films. In this country there had been virtually complete stagnation in the commercial development of 3-D between the experiments of Friese Greene in 1889 and the initiation of the Festival of Britain programme in 1949, a period of 60 years. The Festival programme was carried forward without support from the British feature film industry, which showed little or no interest in what was displayed at the Telekinema ; the 3-D films were severely criticised even in the pages of the *Journal* of this Society, but no attempt was made there to analyze the reasons for its outstanding commercial success and for the world-wide reactions which it evoked.

The same disdainful detachment greeted the efforts made by Milton Gunzburg in Hollywood to enlist the support of the studios in the making of his 3-D film. Conscious of his lack of technical background, he implored their help in supporting the film and giving it the benefit of their knowledge. He knocked on their doors in vain ; no one would help him ; finally he made the film himself, and in spite of its crippling technical imperfections, it became one of the greatest box-office successes of the year. No sooner was its success apparent than the studios, large and small, ordered a spate of 3-D pictures into production, and this in spite of the fact that none of them had studied what had been done before ; none had technicians who were able or ready to grasp the wholly new optical principles involved, or who had given a thought to what a space medium could do beyond the hurling of objects at members of the audience. So the call went out that where one camera had sufficed before, two were now to be used ; and there came into existence the most incredible broadband contrivances in which cameras were mounted at every possible angle to one another with only the very slightest regard for optical accuracy and operational convenience.

As soon as this craze had begun to germinate, a third innovation was brought out,

or rather was dusted off the shelf where it had lain unused for many years. This, the anamorphic lens, was also the invention of someone not connected with the motion picture industry. When interviewed by the press in Paris, Professor Henri Chrétien of the Sorbonne remarked, not perhaps without a touch of irony: "I cannot help but be filled with admiration at what the Hollywood technicians have been able to make out of these few bits of glass which I put together 25 years ago."

When discussing an industry devoid of scientific and technical policy, acting on snap judgments, and whenever possible adopting the easiest solution, it would be foolish to evaluate future trends by any rational standard except the aim of making the greatest amount of money with the least expenditure of mental effort. The aim will be to astonish and stun the public, in fact to produce a sensation, and it is in terms of the impact which the new forms of the cinema can produce that we must try to evaluate them if we are not to fall into sentimental speculation.

Now, within the limits of what can be accomplished to-day, there are only three ways in which the cinema's impact can be increased: first, by enlarging the picture so that to a much greater extent than formerly it appears to engulf the spectator; second, by creating a picture in 3-dimensional space so that objects may be made to emerge from the screen and approach or strike the spectator, as well, of course, as occupying distant space behind the screen; third, by surrounding the spectator with sound, preferably of very loud volume and improved fidelity, it may prove possible to batter him still further into a state of dumb identification with the drama.

I will now deal with these alternatives in ascending order of complexity, and will try to evaluate them in terms of sensation (what is politely called "audience appeal"), taking into account most of the variants which are now under discussion.

Wide Screen Processes

The first essential is to get a bigger picture, which can of course be very simply attained,

especially in to-day's half empty cinemas, by sitting everybody closer to the screen. By changing the front rows of seats, which in Britain are the cheapest, into the most expensive, and the back rows from the most expensive to the cheapest, this revolution could be effected very simply and at almost no cost. I myself would regret the change, because as a large-screen enthusiast long before anyone murmured the word "engulfment," I have been able to buy my entertainment very cheaply.

The next step onward is to make the screen larger than it was previously; and since the screen can seldom be extended upwards or downwards very much without great inconvenience or actual structural alteration, it is practical (as well as fashionable) to increase the aspect ratio. The new aspect ratio will not be less than 1.66, or the change would scarcely be worth while; nor will it be more than 2:1, since beyond this ratio an excessive amount of the image would be lost. But within these limits there is no standardization at all. The ratio is established at the whim of the producing company; and since screens, once masked, cannot easily be altered, we now suffer from the spectacle of important parts of the picture being amputated, or of the projectionist frantically racking up and down to keep it in the frame. To guard against this, directors are now forced to huddle their action together in the middle of the scene, leaving large areas of wasted space above and below when the film is screened at the 3 to 4 proportion. Once an aspect ratio is agreed on, this solution must irresistibly appeal to the film industry, for it is of utter simplicity, consisting of nothing but altering the shape and size of the screen, the focal length of the projector lenses, and two little aperture plates in the camera and the projector respectively.

But this enlarged screen, which is a constant factor in all the proposed pictorial innovations, does in fact raise far more interesting questions. In the cinema of the past, no one thought of aiming at the engulfment of the spectator; a proper distance was established between audience and screen (this is marked

by the fact that in England the more expensive seats are at the back of the house), and subject and object were held apart from one another in a relationship of detachment. As a technical consequence, the viewing ratio was extremely uncritical. The nearest spectator could be at 1.2W (i.e. 1.2 times the width of the screen) and the farthest at 6W or even 7W. It is on the basis of this uncritical ratio that almost all cinemas have been built, and that the exhibitors' profit margins have been established. But if engulfment is to be the order of the day, audiences will become much more critical as to where they sit. They will all want to sit between 1.5W and 2.5W—that is, in the front of the auditorium where fewest seats can be accommodated. Seats forward of this area will have to be removed or priced down because of complaints that the picture is fuzzy, as well as being so large that eyestrain is caused by trying to take it all in at once. Seats farther back than this area will also have to be priced down, since spectators sitting in them are likely to feel that they are not being engulfed, and that this "New Look" in the cinema is really "old hat."

Now when greatly enlarged screens (which can preferably be described as low viewing ratios) have to be applied to very large theatres of 2-3,000 seats or more, far more drastic technical changes have to be made. Historically, the first of these was Cinerama. Now since the advent of CinemaScope it has been fashionable to decry Cinerama as gargantuan and impractical. Gargantuan it certainly is. Cinerama is truly the dinosaur of the movies. Stalking around on the vast prairies which are its natural habitat, this monster is undeniably impressive; but try and curl it up in the living room and you will have trouble in getting its tail in through the door or preventing its head from knocking the plaster off the ceiling. Of course the Cinerama producers know this, and they have wisely (as well as economically) eschewed all notion of stories and stars, and have put their show on as a 3-ring circus. And as a circus it is prodigiously successful. When Cinerama had been running for a year, I was assured both in

New York and Los Angeles that people were going back to see it four, five, and even six times, and this at very high admission prices. It seems that they are unconscious of the gross perspective distortions which stem from the peculiar image geometry, of the lines which visibly divide the three panels, of the relative projector movement, and of the uneven balance of color between the different films. All they are aware of is the stunning physical impact of pictures—no matter how senseless—projected on so vast and highly curved a screen. By our criterion of sensation, Cinerama must be adjudged a great success, particularly as the high admission rates to the four theatres where it is now being shown have enabled the promoters to remove most of the poor seats from the house so that there are comparatively few complaints from the audience. Assuming that a Cinerama picture can be made to run six months to a year, and that only a very few houses are needed in order to show a profit, the demand for new product can be kept very small. This is fortunate, because the system is ill-adapted to all but the largest and simplest spectacles, and because the composition—the camera has triple lenses of only one focal length—tends to become monotonous, and the picture slow.

Next in order comes CinemaScope, more complex than Cinerama in conception because of its ingenious anamorphic lens system. Mr. Spyros Skouras is reported to have called CinemaScope "the poor man's Cinerama." This is rather an apt description, for it attempts to achieve Cinerama's impressiveness by means which are certainly very much cheaper and more practical. The end result, however, may or may not be the gold mine which its promoters confidently expect. As I have already said, CinemaScope was invented by Prof. Chrétien of the Sorbonne whose uncommercial decision to give his anamorphic system a compression ratio of 2 to 1, combined with Edison's 60-year old aspect ratio of 1.33 to 1, resulted in a final aspect ratio of 2.66, which has been only very slightly reduced by the necessity to accommodate the picture and four sound tracks on

one strip of film. Now an aspect ratio of about 2.5 means that in many cinemas where the width of the proscenium is not very great, the actual height of the new screen may be less than that of the old. This results in what has been called a "letter-box effect," because of the strip-like impression which a spectator receives at the back of the house. I speak advisedly of badly built cinemas and badly placed spectators because, with the huge investments which the film industry is making in CinemaScope pictures, distribution will have to be effected not merely to half a dozen or half a hundred cinemas, but to thousands of cinemas all over the world. This will result in a depreciation of the value of CinemaScope, for the critical viewing ratio which is an absolute condition of audience engulfment and heightened impact, cannot be maintained under varied and adverse conditions.

The high aspect ratio also poses difficult problems of composition, for when attention is concentrated in the centre of the screen, the wide wings tend to become empty and lifeless. It may well be that vignetting techniques will soon be introduced, by which the effective area of the screen could be varied at will. Once audiences had grown accustomed to these, they would readily accept them. In a world which changes as rapidly as ours does, and in which the image is again taking precedence over the written word, visual conventions are soon made and unmade. A soft and gradual change in the effective screen area could thus allow the focus of attention to be narrowed and again enlarged as the story demanded. But far more than this is possible. Abel Gance, another French precursor of 20th-Century Fox, in his famous triptych film *Napoléon*, produced in 1928 and revived in original form with the aid of linked projectors at the Venice Film Festival of 1953, made use of the three sections of the screen for simultaneous cross-cutting, so that the action could be single or plural, parallel or conflicting, and dissolves and other optical effects took place in space as well as time. In this astonishing production, even contrasts of colour were effected by contrasted tinting of the three screen sections, ending, it

need hardly be said, with the Tricolor of France itself! All this wealth of technical possibility is at the disposal of CinemaScope, and with the far greater convenience of employing only a single film.

By some such modification as this, one of the most burdensome handicaps of CinemaScope could be overcome: I mean the slowness and staginess of the gigantic tableau of the 60-foot screen—or the viewing ratio of less than 1.5W. One of the most respected American film critics, Mr. Bosley Crowther of *The New York Times*, remarks of *The Robe*:

"The graphic development of spiritual experience is attempted in static displays. The consequence is that the essence of the drama does not come through. A sense of personal exaltation is simply not conveyed, and the movement is not sufficient to keep the huge screen alive . . . It is apparent that intimate personal drama may be lost in such insistent and inflexible large-framing. It is perilous—if not wrong—for the intimate thing. Also there is a serious question as to the width and plane of CinemaScope. It may be too wide and distant for the convenience and comfort of the eyes. Unlike Cinerama, which gives a full "wrap-around" effect and compels a conscious eye movement to take in both sides of the screen, CinemaScope seems to tempt the observer to get the whole screen in one fix. . . . This causes the eyes to "stretch" which can, after two hours, cause discomfort."

And he concludes: "There's more to be said. And it will be."

I have pointed out some ways in which CinemaScope could be made less inflexible than it is to-day; but there remains the fact that no encircling effect is achieved. Though the claim that the picture is shown on a curved screen is strictly true, it is devoid of all significance for the spectator. The curve is too small to have the slightest beneficial effect on the nearness of the wings, and the picture would in fact look slightly less distorted on a flat screen.

From a technical standpoint, the chief defect of present-day anamorphic systems is the poor image quality they reproduce. The Eastman Colour emulsions, under the unprecedented horizontal magnification of nearly 1,000, must bear some part of the responsibility, but since the resolution seems

not greatly different in the horizontal and vertical planes, it is probable that the lens system is chiefly responsible for the fuzziness of the picture. I believe that a great deal more work will have to be done on the aberrations of anamorphic lens systems before they can be considered photographically satisfactory. Meanwhile there is little doubt that audiences will be sufficiently awed by *The Robe* and its immediate successors to disregard blurred pictures, just as they overlook the dizzy distortions of Cinerama.

Summarizing the possibilities of wide screen, Cinerama and CinemaScope in terms of impact, sensation and engulfment, I would say that they can be made to achieve everything that is possible with a purely flat picture, though at present at some considerable sacrifice of technical quality. Only Cinerama has elements of stereoscopic effect, but this does not appear except in shots where the camera is moving rapidly through the scene, a device which soon becomes a cliché. The presentation of perfectly flat images on a huge scale—or, as I have called it, the adoption of low viewing ratios—tends to produce a slowing down of the essential rhythm of the cinema, and also has a somewhat wearing effect on the eyes. In the short term however, it will produce a powerful impact on audiences, but if it is ever to become as popular as the 3 by 4 screen seen at uncritical viewing ratios, which has universalized itself over 60 years, it will need to become much more flexible in technique, and will also call for the reconstruction of most cinemas, with a consequent raising of admission prices. If the net income of the motion picture industry in America is to be stabilized (and it is in America alone that the full impact of TV competition has been felt), it may be necessary to cut down the number of theatres by closing another 5,000, in addition to the 5,000 already reported to be shut. On this supposition, only about 5,000 theatres would remain open in the whole of the U.S.A., and many small centres of population would be without a cinema for the first time in 40 years. While this was taking place, Hollywood production would be cut from the 3-400

pictures a year of the recent past to about 100 pictures, each of them, however, representing a much greater investment than the present average. The studio space no longer required for motion pictures would probably be absorbed by television.

Stereoscopy

Let us turn now to 3-D, the last stage in the ascending order of complexity and therefore, for reasons already given, the least likely to be universally adopted unless it can be very much simplified. The Hollywood conception of 3-D makes it out as little more than a gimmick or gadget for hurling rocks, baseballs, tomahawks, gunshots, etc., into the faces of the audience. This idea came from a pair of very short and very bad films made shortly before the war, these being the last 3-D films to be produced in Hollywood prior to *Bwana Devil*. As producers there are candid enough to admit, they “played 3-D for a fast buck,” basing their estimate of the public’s reaction on an even lower grade of sensation than the one I have singled out as a criterion. For several months the result was a riotous success, but the public soon sickened of an endless round of horrors and missiles. Before the saner producers could exploit the new medium, it was in danger of being run into the ground. In this country the error was avoided by exercise of a peculiarly English trait: the producers showed no interest whatever in any of the new techniques, and to-day, a year after the hullabaloo started, no wholly English company has made a Cinerama or CinemaScope picture, and only one 3-D feature has been produced.

I have said that in its earliest phases the measurable depth dimension in 3-D—the one characteristic which distinguishes it from all the other new techniques—was chiefly utilized for launching things at the audience. A far more interesting and dramatically effective use of space has so far been ignored by Hollywood. The concept of the stereoscopic window had its origin decades ago, but it is only recently, and in this country, that it has been advantageously applied to film. This

is the frame enclosing the forward end of stereoscopic space, or, if you prefer it, the hole through which stereoscopic space is viewed by the spectator. Sheer mental laziness caused the producers to leave the formation of this window to chance, which resulted in its appearing in the same plane as the screen. The result has been that, apart from self-supported and "floating" objects, nothing in current 3-D films comes any nearer to the audience than the screen itself. The reason for this limitation is that objects which are represented by a crossed-over parallax on the screen and at the same time cut its edges are seen as uncomfortably suspended in a sort of nowhere. They are neither behind the screen nor acceptably in front of it. In the centre of the screen they seem to bulge out, but as the eyes travel towards the screen borders they appear to bend back. Their position in space is, in fact, somewhat indefinite. This effect is an unpleasant one and is rightly avoided. In doing so, however, a severe limitation has to be accepted: characters and scenes based on solid ground cannot come forward of the screen; they cannot come really close to the audience. The only way of getting things to come close is to throw them; hence the over-emphasis of this most obvious trick of 3-D.

Now suppose that the screen could be detached from its supports and floated forward to a position midway between its old place and each spectator. To Mr. Brown, who is occupying a front seat 30 ft. from the real screen, this imaginary screen, or "picture-frame in space," will have come forward 15 ft. Mr. Jones, on the other hand, sitting in a back seat 100 ft. away, will see it at a position 50 ft. forward of the real screen. Now imagine that Brown and Jones are watching a picture—each through his own space-frame—in which a large part of the action projects forward from the real screen and comes right up to the space-frame. Between space-frame and screen there is no feeling that objects are suspended, for there is now a perfectly good "floor" for them to stand on; in fact, the completely unobjectionable stereoscopic space, which formerly stretched up

from the distance until it stopped short at the screen, now continues forward to the space-frame. This makes the theatre available for the presentation of solid images, without any restriction as to their being self-supporting. Moreover, it gives both Jones and Brown a preferred seat; for Jones, in moving back from the front of the house, *brought his picture along with him.*

With this new technique, it is evident that the action can be given a far greater intimacy than exists in any film to-day. Mr. Jones, for example, if he were looking at a 2-D picture, or a current Hollywood 3-D film, would not be able to see his favourite star at a distance of less than 100 ft. With the aid of a space-frame, however, she could be brought as close as 25 ft. to him (when she would be only 7 ft. 6 ins. away from Mr. Brown), and would appear in these positions with a completely natural roundness and solidity. The actual screen is now no longer seen, and each spectator has his own private stereoscopic space filling the volume between space-frame and screen and stretching back into the distance.

This fusible space-frame, which has been fully patented by our research group, is one of several ways in which far greater "presence" and intimacy can be given to the 3-D film than can be achieved by merely enlarging the area of a flat picture and equipping it with a fancy name. This, and the increased flexibility of the stereo film in respect of composition and editing must, however, be offset against complications many times greater than are encountered in making flat films, complications which the producers have so far shown little willingness to grasp and overcome. First among these is the design of the 3-D camera itself. For reasons which I have set out elsewhere, it is necessary to be able to vary the effective lens separation from a comparatively large to a very small value—not greater than half an inch. This is optically very difficult, especially since large aperture wide-angle lenses must be employed. The effective convergence of the lenses must be controllable with an accuracy of a few ten-thousandths of an inch, binocular view-finding should be provided, and the whole

double-film mechanism ought to be integrated into a single silenced unit no more difficult to control than a present-day studio camera. No 3-D camera in existence meets these requirements.

Next, the scene before the camera must be filmed with a proper knowledge of the transmission factors involved. Various formulas have been devised in different countries for accomplishing this end, but most of these are woefully inadequate or downright erroneous. It is only within the last two years that this process has been systematically attacked, and the results are to be found in a new book recently published in the U.S., entitled *The Theory of Stereoscopic Transmission*¹. While the findings of this book can be reduced to fairly simple practice with the help of calculators and other practical aids, some groundwork of theory is desirable for the stereo technician, and it is as difficult to inculcate this into empirically-minded cameramen as it was 20 years ago to teach them the theory of sensitometry. There is perhaps no branch of film making in which science is held in such low regard as by cameramen—although in no branch is it more essential, since the chemistry and optics of the image are at the root of the whole film process. This is but another example of the industry's neglect of basic scientific training.

When a 3-D film has been made, it enters the field where its complexity is the greatest handicap of all. Especially in the U.S.A., bad projection has been responsible for much of the adverse reaction to 3-D : prints have been out of synchronism, arcs unbalanced, focus fuzzy, images unsteady, vertical parallax introduced by bad framing, projectors misaligned, illumination inadequate, polarizing filters bleached out or distorted by heat. This catalogue of errors proves, indeed, how much there is to go wrong. No nation-wide scheme for training operators has been provided either here or in America ; no stereo standards have been set up by the Committees of the S.M.P.T.E., the B.K.S., the A.S.A. or the B.S.I.

In the resulting chaos, it is surprising that good box-office results have been achieved

anywhere with 3-D films. Their future success, if it is to depend on the hazard of an unscientific industry, must await the development of more foolproof methods of projection. There are many advocates of a single-film 3-D system who have carefully conned the pages of pre-war German scientific journals in which the Zeiss-Ikon system was described. This system provides means for recording (and projecting) the images through a single lens, the horizontal axis of the picture being turned through a right angle by prisms or mirrors, so that two small images of normal shape can be placed in the area of a single frame. With the large screens now coming into general use, it is impossible by this means to provide either adequate illumination or adequate picture definition. In my opinion, research along these lines is a waste of time and money, except for screens of 20 ft. in width or less. Vastly more promising is the development of colour Vectograph film by the Polaroid Corporation, since in this process two images of full size are superimposed on one frame of film, the images being formed in terms of polarizing inequality. At the present time the final development of the Vectograph process applied to motion picture film is being pressed forward with all possible speed in America, for it will eliminate almost all the problems of 3-D projection—except, of course, the wearing of glasses.

I conclude, therefore, that 3-D films have a potential impact on audiences as great as, and probably more lasting than, the impact of enlarged flat images. For various reasons, however, which stem from the low level of technical competence to be found on the production side of the industry, these potentialities are not likely to be realized at present, and a minimum period of two years must elapse before 3-D gets its second wind. If by that time it has not done so, it may have to wait the 25 years which were the lot of Professor Chrétien and his anamorphic lens.

Stereophonic Sound

I turn now to the third means of increasing the sensation produced by films : stereo-

phonic sound. Here at last we find a development for which the motion picture industry can justly take credit ; for though stereophonic sound was first demonstrated in 1881 (the experiment is described in *Film and Its Techniques*²), and afterwards developed by the Bell Telephone Co. in America, it was first commercially applied to film in Walt Disney's *Fantasia*³. Since the latter part of last year, its use has been ably advocated by Hollywood's sound recording departments, the only groups of trained engineers to be found in the studios. The result is that the innovation which, of the three, is probably the least effective, has received the most intensive development. It seems very doubtful whether an appreciable proportion of *The Robe*'s and *House of Wax*'s audiences were much affected, even subconsciously, by the stereophonic sound, so weak is the directional response of the ears, especially when the eyes are being powerfully stimulated. Off-screen loudspeakers would appear to have a value for startling effects ; but the impression they produce varies tremendously from one seating position to another, and it would require a prohibitive number of sound tracks to graduate these effects at all subtly.

On the technical side it seems likely that the soundhead equipment engineered for CinemaScope has won the day, this being a magnetic device mounted just below the projector upper spool-box, and capable of reproducing four sound-striped magnetic tracks, two inside and two outside the perforations. The picture would thus be restored to the central axis of the film which it abandoned in 1928. This device, once installed, is no more difficult to operate than the single sound track reproducer of to-day, although its much greater cost and complexity are not likely to be offset by any greatly enhanced audience appeal. As incidental benefits to be expected, however, are the abandonment of the obsolete Academy reproducer characteristic in favour of higher fidelity sound, and the reproduction of music from a plurality of tracks and speakers, with a consequent reduction of intermodulation and other objectionable distortions.

Possible Future Trends

In drawing together these assessments of future trends, I suppose I shall have to appear in the dangerous and unwelcome rôle of prophet. Rational forecasts are manifestly uncertain when the important factor may be what kind of aspect ratio makes Miss Marilyn Monroe look most attractive. In the short term, then—that is to say, over the next two years or so—I anticipate that CinemaScope and other compatible anamorphic systems will achieve an output of perhaps 80 per cent of Hollywood's high budget pictures. But I do not expect that more than a relatively small percentage of cinemas will be equipped to project these films in their original form. The largest and most enterprising cinemas will convert to very wide screens; but optical prints will be made by the studios through anamorphic lens systems whereby the central portions of the original pictures may be projected with normal lenses in unconverted theatres. The middle-run of cinemas will show these films, and they will eke out the year with lower-budget pictures shot in the old-fashioned way but for an aspect ratio of about 1.66 to 1. Many of the smaller and the less prosperous theatres are likely to go out of business, especially in the U.S.A. If commercial television finds its way into this country and plays down sufficiently to popular taste, it will react strongly against those cinema interests which are now supporting it, and will still further depreciate cinema investments and property. In this middle future, I do not think that 3-D will play any decisive rôle.

Looking farther ahead, it is impossible to make any prophecy which is not a mere hunch. Assuming, however, that the motion picture industry was forced with its back to the wall to mobilize all the outside scientific talent which it could attract in America and elsewhere, some definite direction which it could take is not hard to envisage. The combination of wide screen and 3-D has often been loosely discussed. This is a confused way of stating the problem, since 3-D by itself can be projected on any shape or size of screen, and a large or wide screen is no less

implied than a small or narrow one. What is necessary is to determine the optimum viewing ratio and the optimum aspect ratio for 3-D films, and then see whether they can be achieved. This problem is discussed in *The Theory of Stereoscopic Transmission*,¹ where it is suggested that seating limits between 1W and 2.5-3W are desirable ; this would call for almost as radical a redesign of theatres as is ideally required for Cinema-Scope. In order to bring about these low viewing ratios in theatres of fairly normal construction, projector lenses of short focal length are needed with very much better marginal resolution than any available to-day. To compensate for high light losses in polarization, it will be necessary to develop further the blown arc, or Ventarc, since current 3-D films are projected as a rule at very inadequate light levels and screens of fully twice the present area will be required by the form of cinema I envisage. The perfection of the colour Vectograph process is assumed so that change-over, synchronization, alignment and light-balance problems will be eliminated. The aspect ratio would probably be lower than 2.5 to 1, but a little higher than 1.75, so that it would require detailed technical investigation before deciding whether an anamorphic lens would merit the extra complication. If it were not used, the horizontal format of the picture might make possible the employment of a 3-perforation frame, so that film speed could be reduced to 67.5 ft. per minute with consequent economy of raw stock. If an anamorphic lens were employed, the picture would become more square, and there would be a greater amount of space available for multiple sound tracks. In presenting the new films, advanced types of forward space frame would be employed, and these, when combined with low viewing ratios, would enable a virtually undistorted action to unfold with its frontal planes only a few feet from the spectator, no matter where he might be sitting.

Both the short-term and long-term prospects I have envisaged make great demands on equipment manufacturers for the development and production of new apparatus.

Soundstripping, magnetic reproducers, Vectographic printing, anamorphic lenses, 3-D cameras, are only a few of the items which will be needed in quantity. It is unlikely that British equipment manufacturers will be able to make more than a few original contributions to this programme, for reasons of which we are well aware although, owing to the dollar shortage, they will doubtless be called on to make copies of American and other designs.

Conclusions

At the end of this embracing and necessarily speculative survey of trends in the cinema, I wish again to make clear what my basic assumptions have been. I have assumed that the American film industry, harassed by increasing inroads from television, will seek to project on its screens something as opposite as possible, something grandiose and sweeping, something which will again infect audiences with a mass emotion which they cannot feel when gathered in little family groups around their television receivers. This kind of film and the mode of its presentation must be assessed, then, in terms of impact or sensation. True, Hollywood producers, aiming as usual too low, have sated the public with stereoscopic brickbats. Now they will find a new level in historical, biblical and musical pictures of vast sweep but little depth. On the technical side, I have taken it for granted that the production companies will continue to ignore basic research, that all scientific pronouncements will be evolved and issued from the publicity departments, and that chaos will continue to reign in the evolution of new film forms.

Had the criteria been different, had it been possible to assume that the cinema was a responsible and serious medium, these arguments would have been very different. The possibilities of the film as it was, had not by any means been exhausted by the end of 1952. Enthusiasm, sincerity, and above all imagination could still produce films which would draw legions of people to the box-office. Once a film captures the attention of the audience, draws them out of themselves and

establishes with them that varying relationship or ebb and flow which alternates between identification and detachment, then the physical problems of aspect ratio and measurable dimensions become of infinitely less importance. Go to the National Gallery or the Tate and enter imaginatively into a favourite picture : you will not find yourself wondering what is the picture's shape or notice at what distance you are standing from it ; you will not be conscious that its surface is merely a flat piece of canvas covered with layers of paint. There will instead, be an instant and powerful rapport between you and it, mediated by what is after all a very simple "mechanism," and one which has

changed surprisingly little in almost a thousand years.

Film, however, has its *raison d'être* as an article of commerce, and it is easier to clip a gadget on to a lens than to deal with so refractory a thing as a writer, whose talent cannot always be curbed or driven, and who may not even be ashamed of associations he once had with groups which have since fallen under a social taboo.

The present moment, therefore, is an opportune one for the industry to take stock of itself in a sober and self-critical spirit. As science, as article of commerce, as vehicle of art, it seems to me that it has fallen sadly short of its great opportunities.

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2. Spottiswoode, R. J. Film and its Techniques, Faber & Faber, 1952.
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DISCUSSION

C. V. JARRATT : Can the speaker give any details of the "Magnarama" system developed by Todd?

THE AUTHOR : I only know that the system uses 65mm. film and a form of anamorphic lens attachment.

C. V. JARRATT : When Todd, who developed Cinerama commercially, realized that the Cinerama means were clumsy he set about finding simpler means for arriving at the same end. With that idea in view he got the American Optical Company to develop a camera which would give a panoramic field of view.

The Todd AO Company has made a contract with Rogers and Hammerstein to have exclusive exploitation of all their musical plays, and is now about one-third of the way through filming *Oklahoma*.

R. L. HOULT : Can the author give more information on the colour Vectograph ?

THE AUTHOR : The Polaroid Corporation has now passed through the most difficult development stage and has reached the stage where it is certain that colour Vectographs can be realized. The Polaroid Corporation, I learn, is going to ally itself to the Technicolor Corporation for the production of prints if the process materializes. An interest is being maintained in 3-D until colour Vectograph is launched. The process has never before been put on to strips of motion picture film and I am sure that very severe difficulties are involved. I have been told that the black-

and-white process has been abandoned as holding up the eventual introduction of colour, because colour is of paramount importance in introducing a new process. The Polaroid Corporation feels that with reasonable luck it ought to have the process functioning, at least on a semi-commercial basis, within about a year.

R. H. CRICKS : Many people object to wearing spectacles to see 3-D. Does the speaker think there will be any alternative ?

THE AUTHOR : I think the wisest thing about this subject was said by Dr. Edwin Land, inventor of Polaroid, who commented that he did not think that such an invention could be realized until some new aspect of the psychology or physiology of vision was lighted upon by research.

It is a conclusion that our people came to more or less at the same time. What Land meant was that the various devices for selecting the image at the screen by means of rasters of one kind or another would pile up complications beyond number and prove themselves commercially unrealisable before a picture was achieved which was commercially acceptable in the cinema.

The person who has made the greatest progress in this, at least on paper, is Dr. Denis Gabor, a lecturer on electronics at the Imperial College. His work, done for the British Thomson-Houston Co. during the war, is of really exceptional brilliance. Gabor

admits that he does not think his system capable of practical realization at present. Putting these solutions aside, there are therefore only trick solutions of the kind which at present do not exist. I will give you an example of what I mean. An inventor believed in what he called "altermittent" vision, i.e., that the eyes see left and right alternately. His idea was that if only the frequency of this "altermittance" could be found, and the two pictures projected accordingly, a perfect separation of the two images would be provided. I think that the idea is crazy, but it illustrates my point of a factor of human vision not yet lighted upon, but which has the means of selection other than by a complex lenticular type of screen.

So little is still known fundamentally about human vision, especially binocular vision, that it is conceivable that such a discovery might be made.

B. HONRI : Has the author any observations on the Ivanoff system ?

THE AUTHOR : The Ivanoff system which was, in effect, a practical realization of the idea of a Belgian, de Noaillon, works within its limits, but these limits are too restrictive to provide satisfactory commercial screening. It seems, from the geometry of the system, that the selection cannot be very good, and that the number of seats in the cinema must be drastically reduced. Probably the most crippling defect is that the audience has to sit in one plane and that the projection beam has to be in the same plane as the audiences' eyes. All of this is discussed in Gabor's patents—one stage of his reasoning defines the de Noaillon-Ivanoff conditions and shows why they would not be practical in the commercial cinema. But I must give the Russian credit for making this idea work at all.

W. S. BLAND : If the Vectograph system is adopted there will have to be increased illumination on one film. What effect will the resultant heat have on this film ?

THE AUTHOR : It should be said that Vectographic film is approximately $\sqrt{2}$ more effective than the double-band version. But it is quite true that there is one arc instead of two, so the heat problem is quite serious. In large drive-in theatres in the U.S.A., where the current rating is as high as 175 amps., forced air and water are used to cool the film down.

It is very possible that the very thin base now being introduced by DuPont will buckle less, because it will have more radiating surface for its volume.

B. S. CHADWICK : What tolerance should be allowed in the matching of lenses for projectors ?

THE AUTHOR : They should, in principle, be as accurate as the camera lenses, which we try to match to ± 0.25 per cent. In that respect I think you are completely in the hands of the manufacturers.

F. G. GUNN : What observations had the speaker on curved screens ?

THE AUTHOR : A curved screen tends, when it is of the high reflectance type, to make the reflectance

more uniform to a person sitting at the side of the cinema. Also the focal plane of projector lenses is noticeably concave, and therefore, by curving the screen out slightly, the definition at the edges is improved. But when the curve is carried to excess, as in Cinerama, for the sake of engulfing the audience, the distortions are severe. Only because the whole effect is so impressive do audiences tend to overlook these distortions.

W. S. BLAND : I was very interested to hear the suggestion for the use of a frame three perforations in height, using the Vectograph system, because if the left and right eye images were printed on one film with a suitable separation for the two optical systems, with a frame height of three perforations and running at 16 frames per second, the film speed would be 90 feet per minute. This would mean that the present recording apparatus could be utilized for making the necessary sound tracks.

THE AUTHOR : That is an idea we had in mind about a year ago. However, we felt with Vectograph coming along it was unnecessary to devise ways in which the two images could be put one above the other or side by side on film. The new magnetic materials being introduced for *The Robe* have a very high coercivity and will give a signal/noise ratio approximately 15-20 db higher than the best that can be achieved to-day.

R. L. HOULT : I understand that CinemaScope, with four magnetic recording channels, will necessitate a change in the standard perforation. What is the American reaction ?

THE AUTHOR : I discussed this point two weeks ago with an American technician, who said that the new sprockets would only necessitate a relatively small and inexpensive change in projectors. When asked whether the new prints, on account of their smaller perforations, would have a shorter life, he said that probably they would, but that the life of prints was not determined by print wear, either of perforations or by scratching, but generally by the obsolescence of the films themselves. With the new perforations, wear tests have shown that films would run 500-600 times through the projectors with reasonable care. When asked whether any picture unsteadiness would be caused by projecting film with old fashioned larger perforations on the new sprocket, the technician said that tests had shown that adequate picture steadiness could be achieved.

When, in England, I asked one of the laboratory chiefs for his views, I was told that there was much anxiety about getting the film through the developing and printing machines when it had different perforations. The cost of equipment conversion would also be a difficult problem.

A MEMBER : What causes eyestrain ?

THE AUTHOR : We were discussing this the other day with the Medical Research Council, who I hope are going to do some experiments, because the reasons

for eyestrain are not yet fully known. They rather depressed us at the beginning by saying : " What do you mean by eyestrain ? " We said : " Oh well, you know what it is. When you feel it you say ' I am suffering from eyestrain '." But that is not enough for scientists.

The conception of eyestrain is too nebulous yet to admit of accurate scientific research. But I do not want to just by-pass the question in that way, so I shall rapidly cover the principal causes of eyestrain in 3-D pictures and explain which ones are and which ones are not inherent.

The first and perhaps the most difficult cause of eyestrain to understand, is that in 3-D pictures your eyes are always focused on the plane of the screen whether that is 20, or 30 or 60 feet away from you. But they are converged on some imaginary point in space where you are seeing part of the stereo image. Now in ordinary vision your focus and convergence move pretty well together as you shift them from a near to far object or back again, and it therefore requires a certain amount of exercise of the eye muscles to detach these two functions from one another. Now, with a little practice, most people can do this quite readily up to limits which, however, vary a good deal from person to person. The very young can juggle around with their eyes in a most extraordinary fashion, and certainly for short periods you can bring images out to what we call nearness factors of 15 or 20, that is 14/15 or 19/20 of the distance from you to the screen. But it would be very uncomfortable to hold them there for long, and it was thought at one time that most of the eyestrain from coloured 3-D films was due to that factor. We have made experiments by eliminating all the other factors and find that they can be made to come very close without inducing eyestrain in the majority of people.

Other causes of eyestrain arise in projection and come from the two images being displaced vertically with respect to one another. Even a very small angle of vertical squint is exceedingly unpleasant because it does not occur in nature. Lack of synchronization between prints causes what we call heteroscopic defect. That causes very acute eyestrain very quickly.

Out of focus in one or other of the pictures does so too, as does unequal illumination of the two prints. The Polaroid Corporation in America has made some experiments on that recently. They think the balancing of prints and of arcs is one of the most serious factors. All of these will, of course, be eliminated by the Vectograph process.

In other words, anything which makes the two images different from one another, except the stereoscopic parallaxes themselves, causes eyestrain, because what the eyes are doing is to try and rectify or adjust the picture to make it easy to view. When that happens both the eyes and the mind protest.

The other thing that very commonly causes eyestrain in commercial 3-D films is the excessive divergence of the backgrounds ; that is, if the far points in the scene are set more than eye distance apart. The eyes, which must be imagined as connected by threads to what you are looking at, are forced gradually to toe outwards and that very seldom occurs in normal vision and is very painful. It is now commonly said that the maximum angle of squint outwards should be about $\frac{1}{2}^{\circ}$, which means that the separation on the screen, which is worst for the nearest people, ought not to exceed 4 inches, when theoretically it should be 2½ inches. It must never rise to figures like 10, 12 or 18 inches as you can easily see it does on big screens when you take off your glasses and look at the two images together.

Those are the principal causes of eyestrain.

THE LIBRARY

In addition to those listed in the 1952 Library Catalogue, the following periodicals are now available for reference in the Library.

Proceedings of the Physical Society (Section B)
Physics Abstracts
Proceedings of the Institute of Electrical Engineers
(Part 3 : Radio and Communication Engineering)
Osram Bulletin
Critics Choice
Bulletin d'Information de la Commission Supre.
Technique du Cinéma

Imagery
Light and Lighting
The Theatre Industry
Transactions of the Illuminating Engineering Society
The Gramophone
The Projectionist's Magazine (Japanese)
Transactions of the Institute of Marine Engineers.

NEW EQUIPMENT

As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of news items does not constitute an endorsement.

EKCO-VICTOR PROJECTOR FOR 16mm. MAGNETIC FILM

OF the 16mm. magnetic-optical projectors currently in production, the Ekco-Victor is, at £295, the least expensive. For many years, the Victor has used a non-rotating sound-drum, easily detachable from the machine. This feature is now a substantial asset, for it allows the additional components for magnetic tracks to be supplied as attachments which the least technical of users can fit or dismantle in a few minutes. Since no mechanical or electrical changes are necessary owners of the Victor can buy the necessary magnetic assemblies in the form of a conversion unit as illustrated for £57 15s.

The first stage of conversion is to replace the normal sound-drum by the magnetic drum—an operation requiring no tools. The magnetic drum contains a record/reproduce head, a separate erasing head and a hum-bucking coil.

A screened lead connects the two magnetic heads to the recording console, which contains a 110V. power pack. In recording, this lead carries amplified speech currents and a.c. bias and, on a second pair of conductors, an erase current derived from the biasing oscillator. A neon indication of recording level and monitor headphones are provided, and there are two separately-controlled input channels on the console.

Recording, but not playback, can be done with the projector amplifier switched off. Signals from the striped film pass to the recording console, and, after amplification, back to the projector amplifier through the "non-sync." socket.

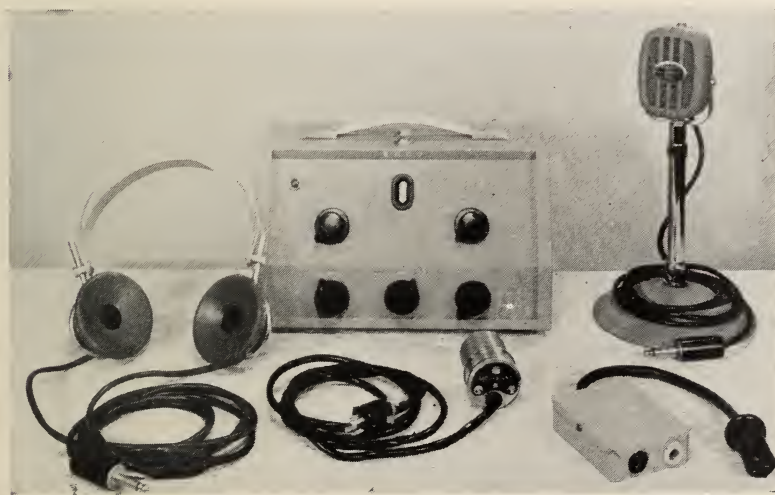
Safeguards are provided against inadvertent erasure. The microphone can be used either on the recording console or up to 10ft. from the projector to reduce pick-up of projector noise. Recording and playback volume are controlled at the console.

With careful microphone placing recordings of excellent quality can be made and magnetic recordings at 16 p.s. compare well with many 24 p.s. sound films.

Satisfactory sound can also be obtained, with some increase in noise level, on a half-width magnetic stripe.

This magnetic conversion unit has been developed by :

**The British Victor Division
of E. K. Cole Ltd.,
5 Vigo Street,
London, W.1.**



(Block courtesy "Film User.")

CINEMASCOPE

CINEMASCOPE is a system for the practical presentation of pictures on a wide curved screen, combined with true stereophonic sound ; it is designed to approach realism in motion picture presentation. This realism is possible because the CinemaScope scheme permits using lenses during photography to give the most natural perspective ; the angles of view approach those to which we are accustomed in life ; all the factors of depth perception are used.

CinemaScope is not a so-called 3-dimension system, nor a temporary expedient of wide screen presentation. The stereophonic sound associated with CinemaScope is not a compromise ; the CinemaScope system of picture presentation is a completely engineered system of anamorphic lens, special screen and true stereophonic sound, all films being produced by Twentieth Century-Fox in CinemaScope have been staged and photographed in this medium. CinemaScope is an integrated whole, no separate part

of which, be it lens or screen, can be used alone without grave detriment to the new form.

In photographing the picture an optical attachment, known as an "Anamorphic," is fitted to the camera lens. The anamorphic attachment records a wider picture than the conventional camera lens but does not affect the height, the result being as though the picture were photographed with a wide angle lens in a horizontal direction and with an ordinary lens in the vertical direction. Observation of the film shows the image to be compressed horizontally. By fitting an anamorphic attachment to the existing projector lens, the image is restored optically to the proportions of the original scene. If a short focus lens has been fitted to the projector for use with the so-called wide screen, this must be replaced by the original lens used for the conventional 4 : 3 picture ratio.

The great width of the CinemaScope picture has caused uninformed people to fear the appearance of a ribbon of picture or a letter box. This fear is quite unfounded since the height of picture is determined by the sidelines of the theatre and every effort should be made to preserve the picture height as in the theatre at the present time. Once the height of the picture is established, the width for CinemaScope is determined by the aspect ratio at 2.55 times that height. This gives a picture roughly twice as wide as the conventional 4 by 3 picture for the same height. If a situation exists in a particular theatre which positively limits the picture width, then the height is determined by dividing the maximum width by 2.55. In a number of small theatres it has been found that, with thought and engineering ingenuity, it is possible to install a screen of considerable width and the resulting picture height for CinemaScope remained the same as the former height in the theatre. If the existing projector lens is used in CinemaScope the image on the screen will have a greater height by approximately 19 per cent. Since a larger picture results from the CinemaScope system, screen luminance would suffer unless the efficiency of the screen could be improved or the projector illumination increased. It was for this reason that the Miracle Mirror Screen was developed.

The screen recommended for use with CinemaScope is the controlled reflectance type, with a metallic surface, and the Miracle Mirror Screen was developed specifically for presentation of films by the CinemaScope system. The screen is designed so that, within the normal theatre seating region, the distribution is quite uniform. The uniform area of distribution includes 30° above and below and 50° to each side of a line perpendicular to the screen. It will, therefore, be recognized that the typical theatre is adequately covered. There are two types of Miracle Mirror Screen; one pattern for "head-on" projection and a tilted pattern for "high-angle" projection. The choice of pattern depends on the theatre conditions determined at the time of survey.

CinemaScope employs four magnetic tracks for stereophonic sound. Three tracks are for the main loud speaker system centre, left and right behind the screen, and the fourth track on a 12 kc carrier, is for the operation of auditorium speakers. Preceding the power amplifier is a simple amplifier-rectifier combination and a separation circuit. The separation circuit routes the audio signal through a low-pass filter and a low-gain (approximately 10 db) amplifier which is normally biased to depress the gain of the channel at least 30 db. The 12 kc control signal is derived from the complex signal by a sharply tuned circuit, is rectified and supplies a bias to the amplifier which restores the gain to normal when the signal is present. The bias circuit is so arranged that when .05 volts or more of 12 kc component is presented to the input terminals of the control device, the amplifier bias reaches a predetermined value; thus the gain is not variably controlled and the system operates as a simple on-off scheme. The gain of this channel is adjusted to produce a surround level compatible with the screen loud speaker levels.

Audience participation is greatly enhanced by this fourth track.

20th Century Fox Ltd.,
Soho Square,
London, W.1.

PERSONAL NEWS OF MEMBERS

Members are urged to keep fellow members conversant with their activities through the medium of
BRITISH KINEMATOGRAPHY.

N. Leever (Fellow) designed the magnetic tape recording equipment now being used by the B.B.C. mobile recording engineers and by British Movie-towns to cover the Royal Australasian tour.

The recent operation of separating the three-months old West African "Siamese" twins was filmed by Stanley Schofield. Obviously a film record

of such an event is invaluable for teaching purposes and a very careful study of the requirements from a scientific standpoint was made by Mr. Schofield. No funds were available for the production of the film and so Mr. Schofield decided to produce it at his own cost and present it as a contribution towards the advancement of science.

BRITISH KINEMATOGRAPHY

VOLUME 23 No. 6

HON. TECHNICAL EDITOR:
R. J. T. BROWN, D.S.C., B.Sc. (Fellow)

DECEMBER, 1953

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NEW TECHNIQUES

THE present year has witnessed an unusual and violent conflict of ideas and techniques, and these closing days find the film industry in a state of confusion and indecision. It was but a few months ago that the naïvely conceived and ill-produced film *Bwana Devil* caught the public fancy and became a financial success. Hollywood, quick to grasp the potentialities of a novelty, plunged into the immediate production of three-dimensional films, giving the camera operatives and technicians scant time to study and to become masters of the new medium. The result of this precipitate action was the wide-spread public complaint of eyestrain, headache and nausea. And thus the interest in 3-D films has waned, before a single film, worthy of the new art form, has been made.

Whether or no the 3-D film is permitted to re-establish itself remains to be seen ; but it is to be hoped that a British producer will be found who will appreciate the patient and unpretentious work of a handful of technicians in this country who have striven towards a complete and masterly control of this space medium. There can be no doubt that the plasticity of the 3-D film can raise a motion picture into the realm of

reality, can heighten its æsthetic qualities and can broaden its emotional appeal.

It was at mid-summer or thereabouts, that the coming event of the panoramic screen cast its shadow on the industry in this country. With an almost reckless abandon, exhibitors rushed to fit their cinemas with screens of all shapes and sizes, paying little heed to the compositional values of the films they were showing. The critics and public alike complained that in close-ups, the artists were either scalped or had their chins cropped off at the whim of the projectionist. But exhibitors realised that this state of affairs could be transitional only ; and thus the B.K.S. was invited to hasten its investigation of the optimum screen ratios that can be accommodated in existing cinemas.

An interim report has been published. It has been adopted by the exhibitors and has received praise in the Trade press. It is to be hoped that this initial work will assist the industry to maintain that degree of standardization and interchangeability that is essential to a medium that is universal in its application and use.

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THE IMPACT OF THE CORONATION ON THE B.B.C. TELEVISION FILM UNIT

P. H. Dorté, O.B.E. (Member)*

Read to a meeting of the Television Division on October 28, 1953

LONG before Tuesday, June 2, was officially nominated as Coronation day, the B.B.C. Television Service had commenced its forward planning. This included not only the most important item of all—the deployment of a considerable number of outside broadcast units so that the Coronation scene in London could be televised from the route and from Westminster Abbey itself—but arrangements whereby this seven hour outside broadcast could be relayed simultaneously to television systems in Western Europe and recorded with two separate ends in view; that every minute of the event could be preserved on film as a national archive and that, without prejudice to this, a very much shortened version could be made quickly enough for re-transmission at home, in Europe and in North America the same evening.

Although by dint of special studio programmes and outside broadcasts the British television viewer was likely to learn a very great deal about the Coronation before Coronation day, it was felt that television viewers overseas might well find acceptable two or three weeks in advance of the Coronation some carefully designed film programmes on what the Coronation was all about—its temporal as well as its ecclesiastical significance.

A small additional production unit was formed on June 3, 1952, to make three half-hour films under the respective titles: *When the Queen is Crowned*, *The Second Elizabeth* and *What is the Crown?* These films did what they set out to do, and the figure given by our Audience Research Department suggest that we were right to televise them here at home as well.

An excerpt was projected from What is the Crown? in which His Grace the Archbishop

of Canterbury discusses the Coronation ceremony. The very slow tempo to which television films are deliberately made was plainly seen.

Coronation Day Plans

While these films were in production, plans were made for all the film work to be done on Coronation day. This was to be a special one-hour edition of television newsreel with accent on those things which, because of time or other elements, would not be covered in the outside broadcast; for example, the crowds on the Coronation route staking their claims twenty-four hours beforehand and cheerfully bedding down on the pavements for the night. It would include two separate tele-recordings for the purposes already mentioned and a long film showing how the Coronation was celebrated throughout the Commonwealth and Empire.

It is now well-known that the B.B.C. television newsreel unit normally produces a 1,290-foot daily edition of television newsreel, and that if time presses we transmit negative picture using phase reversal, and that, by using 35mm. magnetic sound-stock we can record to within a few minutes of transmission¹. So the Coronation day plans would not demand something extraordinary from a technical point of view—they would call for a longer edition than usual, and this extra length would be partly compensated for by the fact that the newsreel transmission would not be until 9.23 p.m. instead of the usual 8 p.m., and, as the television programme on Coronation evening would include an edited tele-recording of the Abbey Ceremony, newsreel would concentrate on exterior scenes.

To do this, and to cover the processions from the greatest possible number of angles,

* Head of Television Films, The British Broadcasting Corporation

more film cameras were needed than for a normal assignment, and the television news-reel unit borrowed nearly every cameraman and every reserve film camera in the television film department. Sixteen cameramen, operating from 22 different points, were stationed along the route ; many of them took up their positions the night before, complete with iron rations and sleeping bags. Owing to the police restrictions on movement in the Coronation area the job of getting the film from the camera positions to the laboratory presented quite a problem, and we were deeply grateful to the Royal Corps of Signals for coming to our aid with twelve uniformed despatch riders, each of whom had a specially planned route to follow.

Preliminary Shooting

Some of the cameramen were at work throughout the night filming scenes of the crowd settling in, and the first despatch rider reached the laboratories at 7 a.m. Throughout the next twelve hours this news-film continued to arrive and was developed in high-speed baths. At Alexandra Palace a team of eight picture and sound editors were at work, and the screening of rushes went on almost continuously from 10 a.m. until 9 p.m. The dubbing session started in the middle of the afternoon, but, owing to the fact that the return procession was slowed down by the weather, the last reels were delayed by an hour and a half. This meant that the recording of reel 11 was not started until reel 10 was actually being transmitted, and by then there was virtually no time for scriptwriting, and none for rehearsal. This last reel was finally loaded on the machines just two and a half minutes before the change-over cue dots appeared on some 2½ million screens.

An excerpt from a reel of the Coronation TNR was then projected.

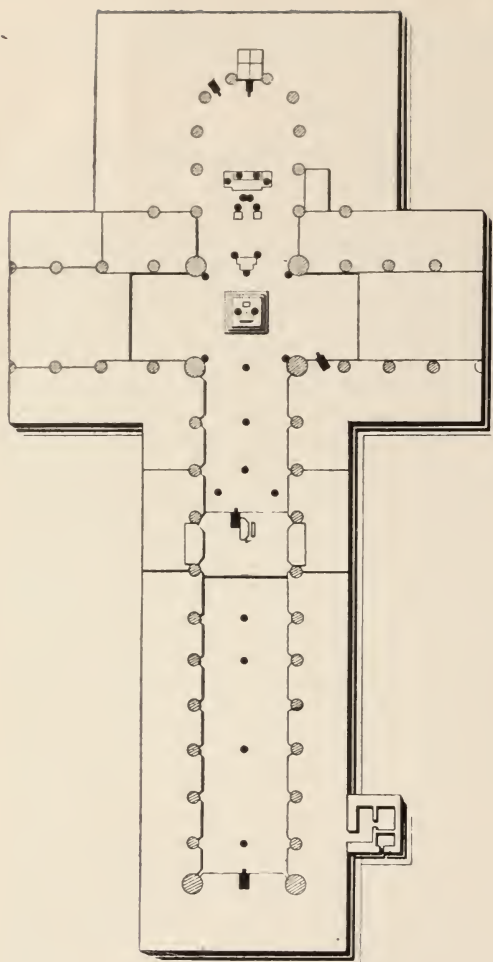
During the twelve hours starting at 7 a.m. on June 2, no less than 80,272 feet of negative and 199,115 feet of print were handled for the B.B.C. by Kays, Finsbury Park Laboratories. Although television news-reel accounted for much of the negative

involved, the balance and virtually all the print was tele-recording footage.

Camera Positioning

The outside broadcast which was to be recorded was to run from 10.15 a.m. until 5.01 p.m. and was to cover the procession from Buckingham Palace to Westminster Abbey, the Westminster scene both outside and inside the Abbey, the return procession to Buckingham Palace and the Queen's appearance on the balcony. Later in the evening the Royal Air Force fly-past was to be televised as well as the re-appearances of Her Majesty on the balcony a few minutes after 9.0 p.m. and at 9.40 p.m. To this end, twenty-one electronic cameras were deployed—one on the roof of Buckingham Palace and one in the forecourt, three on the Victoria Memorial, three on Victoria Embankment, one on Abbey House at the junction of Victoria Street and Tothill Street, three on the Colonial Office site, one in the Abbey annex, four in the Abbey itself, one in the Abbey control room and three near Grosvenor Gate and Hyde Park. Each batch of cameras had, of course, its own control room, several cameras were equipped with 5 - 1 zoom lenses and one of the cameras on the Victoria Memorial was equipped with a 40-inch telephoto lens. The engineering work and planning involved was of enormous proportions.

One of our duties was to ensure that every minute of the historical television outside broadcast on Coronation day should be preserved as an archive, and it was desirable, therefore, that the negative should not be cut in any way to provide shortened versions of any parts of the day's ceremonial for whatever purposes they might be wanted. So it was decided that the tele-recording channels at Lime Grove should be used for this purpose and that their output should only be developed and printed on Coronation Day itself as an insurance against the failure of the additional recording system which would be specially built and installed at Alexandra Palace to provide edited versions—and this plan was duly carried out. The archive recording



The camera and microphone positions inside Westminster Abbey.

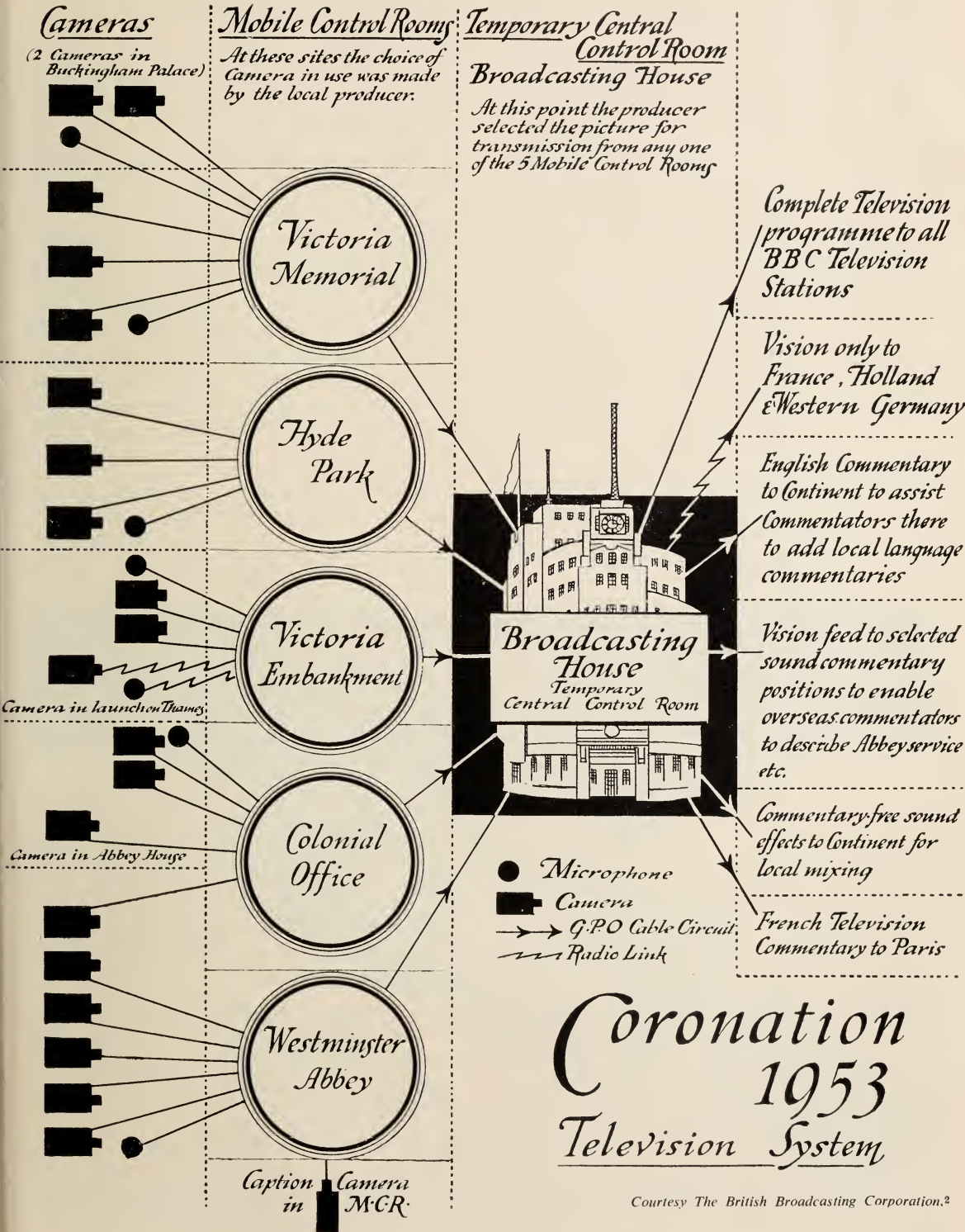
The temporary B.B.C. television control room at Westminster Abbey. In this room the outputs of the cameras and microphones in the Abbey were selected and mixed to provide the television programme of the Coronation service.



must certainly be amongst the longest films ever made ; it is 43,040 feet in length, and at our projection speed of 25 frames per second it runs 7 hours 39 minutes. It was photographed, developed, edited and printed within twelve hours.

Tele-recording

Applications were received from the television broadcasting organisations of many countries for copies of our tele-recording to be despatched in time for local transmission on Coronation night—but the most important, because it came from the only country in the Commonwealth with an operational television service, was that from Canada. The problem thus arose as to what we could let Canada have—and how we could get it there, bearing in mind that nothing must interfere with our domestic plans which had to take into account the fact that, although the daytime outside broadcast would probably have a home audience of something like twenty millions, there would be a demand for a filmed repeat that night. After considerable discussion, it was decided that our



Coronation 1953 Television System

Coronation day evening programmes should take the following form :—

p.m. p.m.

- 8.00— 8.55 An edited version of the recording of the Abbey ceremony.
- 8.56— 9.07 The Prime Minister's address from 10 Downing Street, and the Queen's Broadcast from Buckingham Palace (in sound only).
- 9.08— 9.22 An outside broadcast of the scene outside Buckingham Palace during Her Majesty's first evening appearance on the balcony.
- 9.23— 9.42 The first section of the special Coronation edition of television newsreel.
- 9.43— 9.49 An outside broadcast of the scenes outside Buckingham Palace during Her Majesty's second appearance on the balcony.
- 9.50—10.22 The second section of television newsreel.
- 10.23—10.28 A short illustrated talk on the timely news of the conquest of Mount Everest.
- 10.29—11.26 An outside broadcast of the Coronation firework display.
- 11.27—11.32 A final visit to the sanctuary in Westminster Abbey.

Overseas Television

Overseas television would clearly want the recording of the Abbey ceremonial and, as they would wish to have a recording of the procession also, as early as possible, it was decided that the procession which would be specially recorded for this purpose should be the morning one from Buckingham Palace to Westminster.

Three R.A.F. Canberra jet bombers were allocated to fly to Canada, leaving London Airport at 1.30 p.m., 3.00 p.m. and 6.00 p.m. respectively, and arriving in Canada a little over five hours later. With the Coronation traffic at its height there was the danger that

it might take nearly as long to get from the laboratories to London Airport as from London Airport to Canada, so once again the R.A.F. came to the rescue and flew the prints from Alexandra Palace to London Airport by helicopter.

The times at which the Alexandra Palace recordings would have to be curtailed in order that they could be developed and edited was a function of the number of prints needed, and this became embarrassing when not only did the number of European countries requiring prints grow appreciably, but a number of American television networks also asked for copies, the attraction being that if the proposed take-off times were achieved, it would be possible to start televising recordings in North America at what, in Britain, would be tea-time.

The Canadians asked for permission to make in addition their own 16mm. recordings at Alexandra Palace so that, by installing high-temperature processing equipment, they could ship these recordings in the same helicopters and Canberras as would be carrying the B.B.C. 35mm. prints, and it would be possible by this means to have later, although possibly lower quality, recordings to choose from on the Canberras' arrivals in Canada. We naturally agreed and immediately the American networks followed suit, although with sundry variations which included in one case the use of a non-R.A.F. Canberra which in fact turned back shortly after it reached Ireland, and a Strato-Cruiser which was converted into a laboratory-cum-cutting room which *did* arrive in the United States but some considerable time after the R.A.F. Canberras' load was already on the North American air.

The optimum lengths of the various reels of the Alexandra Palace recordings were calculated so that the developing and printing machines at Kays Laboratories could be continuously fed.

The B.B.C., Canadian Broadcasting Corporation and American recordings are estimated to have been seen that afternoon and evening by some eighty-seven million

viewers on the continent of North America. Excerpts from two reels of the B.B.C. tele-recording were shown.

"Her People Rejoiced"

There was also a requirement as soon as possible after the Coronation for a film showing how the Coronation was celebrated throughout the Commonwealth and Empire, and in November 1952 during a Commonwealth Prime Ministers' meeting in London we were able to enlist their active support. Between then and Coronation day, the producer of the film travelled thirty-two thousand miles lining up coverage to be shot on Coronation Day.

Each participating country was asked, in

order to help the editors in London, to observe a shooting ratio of not greater than three to one but there was much overshooting. When the film was transmitted a fortnight after Coronation day, the editors had reduced to some seven thousand feet an input of over seventy thousand.

This film, *Her People Rejoiced*, contained film from the Dominions, Canada, Australia, New Zealand, South Africa, Ceylon and Pakistan, from Colonies like Rhodesia, Uganda and Malaya, from India, from the Carribean and from tiny outposts like Cyprus and Hong Kong. It was a notable example of co-operation.

Sequences from Her People Rejoiced were projected.

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2. "The Year that made The Day," B.B.C. Publications, 1953,



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STUDIO SPOTLIGHTS

Summary of Tests

A SERIES of tests was recently made in the laboratories of The Morgan Crucible Company Ltd. to provide data for the British Standard on studio spotlights.[†] The results, although not conclusive, provide some useful information which is summarized here by permission of the Company.

Four manufacturers were invited to supply complete spotlights for test, each spotlight being complete with lamp and lens. The ratings were 500W., 2kW., and 5kW. To preserve anonymity the various makes are coded under letters in the tables of results.

Nature of Tests

Polar Curves. These were taken on each spotlight as received from the manufacturers, the light being measured by a photo-cell corrected to "average eye" response. The applied voltage throughout the tests was maintained at $115V \pm \frac{1}{2}V$. For the purpose of drawing the curves the readings were converted to foot-candles at a distance of 13 ft. 6 in., but other readings are given in arbitrary units in the tables.

Lamphouse Factor. This is the ratio of the luminous intensity given by the complete unit to that given by the lamp alone. To determine this, readings were taken as for the polar curves and the lens and reflector were then removed and a second set of readings taken.

Lens Factor. This is taken as the ratio of the luminous intensity of the lamp and lens to that of the lamp alone. After the lens and reflector were removed for the previous test the lens alone was replaced and a further set of readings taken.

Temperature Rise. The measurements were taken with a surface pyrometer at 5 minute intervals for the first 30 minutes and thereafter at 10-minute intervals until three consecutive readings were constant.

The measurements were taken on the outer surface of the equipment as information was required on the possibility of burns or discomfort to the user rather than liability to scorching or internal strain.

General Note on the Tests

It should be noted that the tests were made as far as possible on the equipment in exactly the state in which it was supplied by the makers. The lamphouse units were not specially selected for the tests.

The conditions under which the photometric tests were made were those which were standard in The Morgan Lighting Carbon Laboratory.

Results of Tests

The polar curves of the various equipments are shown in the graphs of Fig. 1. The angular beam spread as indicated by these curves is given in Table I. The spot and full-flood measurements were made with the lamp at the limit of its travel away from and towards the lens. For the half-flood position the lamp was precisely placed by measurement midway between these limits.

Table I
BEAM ANGULAR FLOOD
(Half angle—in degrees)

Rating	Spot	Half-flood	Flood	Maker
500W	$7\frac{1}{2}$	19	> 22	A
	$7\frac{1}{2}$	20	> 22	B
	6	$15\frac{1}{2}$	> 22	C
	6	14	22	D
2kW	8	14	22	A
	$6\frac{1}{2}$	14	> 22	B
	$8\frac{1}{2}$	15	22	C
	$6\frac{1}{2}$	15	22	D
5kW	9	20	> 22	B
	9	17	> 22	C
	8	15	22	D

[†] B.S. 2063 : 1953

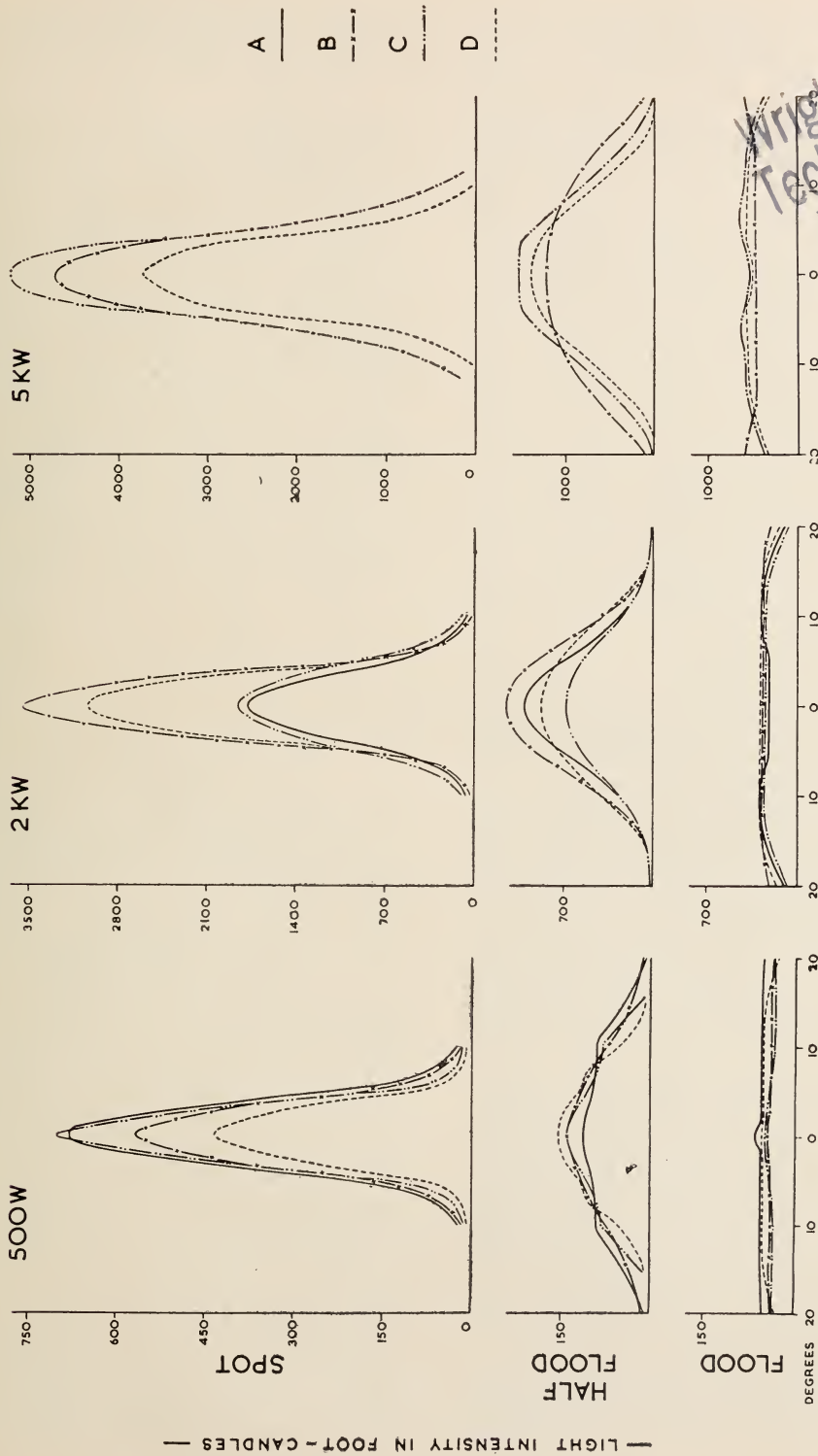


Fig. 1. Polar curves of various equipments.

Wright-Patterson
Technical Library
Dayton, Ohio

Table II
(a) LAMPHOUSE FACTOR
(b) LENS FACTOR

	Spot		Half-Flood		Full-Flood	
	(a)	(b)	(a)	(b)	(a)	(b)
A. 500W...	76	51	15	10	6	4
B. 500W...	77	58	19	14	5	5
C. 500W...	74	57	15	11	5	4
D. 500W...	50	43	18	12	7	4
A. 2kW ...	40	31	22	12	5	3
B. 2kW ...	70	48	22	16	5	4
C. 2kW ...	42	37	15	12	6	5
D. 2kW ...	62	46	20	13	6	4
B. 5kW ...	51	38	12	9	5	3
C. 5kW ...	52	38	14.5	11	5	4
D. 5kW ...	51	37	13	10	6	4

Lamphouse and Lens Factors

Table II gives the results obtained. An interesting observation was made on the 5kW lamphouse marked "D." When the equipment was tested as received the figure for lamphouse and lens factors were 37 and 31 respectively, and these correlate with the polar curve readings shown on the graphs.

When the equipment was stripped down in the course of testing and reassembled by the Laboratory staff the improved performance indicated by the figures 51 and 37 was obtained. This indicates that test results are liable to serious discrepancies unless the spotlights are assembled under laboratory conditions, particularly in the optical alignment.

Effect of Interchanging Lamps and Lenses.

By interchanging lenses of British manufacture no appreciable difference was detected. The substitution of an American lens reduced the total light output by about 15 per cent and the peak intensity by about 30 per cent in the spot and half-flood positions.

In studying the polar curve (Fig. 2), the following must be borne in mind :

- (a) The comparison of British and American lenses is on a basis of direct replacement without refocusing. The design

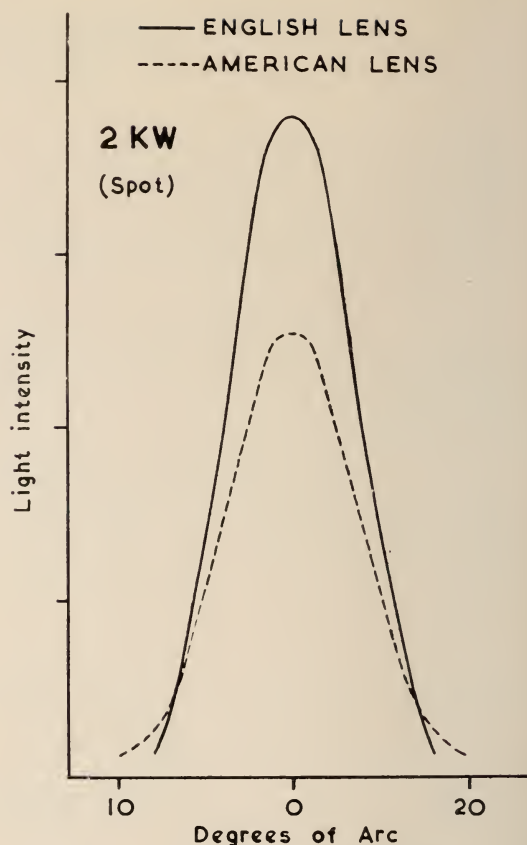


Fig. 2. Polar curve showing comparison of British and American lenses.

Table III
REFLECTOR EFFICIENCY

500W	...	...	...	{	A.	47
					B.	43
					C.	10
					D.	14
2kW	...	...	...	{	A.	68
					B.	74
					C.	61
					D.	55
5kW	...	...	...	{	A.	48
					B.	83
					C.	22
					D.	43

of each lamphouse and lens does not necessarily permit this to be done without affecting the light distribution in the beam.

- (b) In each case the lamp was at the maximum distance from the lens, which may not correspond with the position of optimum performance in every case.
- (c) The curves suggest that the American lenses have a somewhat longer focal length than British lenses. The American lens is dished, while the British lens is flat ; accordingly in any given lamp position the beam divergence is liable to change with the type of lens used.

Simple replacement of one lens by another cannot therefore be used as a basis of comparison between lenses. From the point of view of standardization the test results indicate the effect that such a change might produce.

The American lens has a 5 per cent cyan green colour when compared directly with a similar-sized British lens.

It was noted that the filament construction and mounting in 500W projector lamps varies markedly between manufacturers.

Effect of Reflector

The figures given in Table III are the percentage increase in the intensity in the direction of the axis of the lamphouse (with lens removed) when the mirror was inserted. The values depend greatly on the lamp filament construction and on the positioning of the mirror. They do not represent the increase in the total light of the beam and do not form an estimate of the efficiency of the mirror. The figures do, however, serve to indicate the great effect that the mirror has on the illumination measurements.

NEW BRITISH STANDARD

B.S. 2063 : 1953 — Studio Spotlights

THE British Standards Institution has recently issued a standard for studio spotlights, which has been prepared at the request of the British Film Producers' Association. The standard relates to three sizes of spotlights using, respectively, 500W, 2kW and 5kW filament lamps.

It was originally felt that it should have been found practicable to prepare a standard which would deal not only with the general dimensions and construction of spotlights, but which would also specify quantitatively their optical performance. Comprehensive optical performance tests, published in the preceding article, were carried out on commercial spotlights, and whilst the results of this research were of considerable interest, it was seen that optical performance tests were of such a nature that they could only be done under the closely controlled conditions of a research laboratory, and that even under such conditions, the variation likely to be obtained in the results would be considerable. For

these reasons, it was finally considered that the desired practical aim of establishing a reasonable uniformity in the performance of spotlights could be as well achieved by a control of the essential dimensions of the optical system as by any attempted photometric standard.

The standard accordingly specifies the essential features of construction of the optical system and the lamphouse, and prescribes the diameters and focal lengths of the lenses and the maximum and minimum angles of divergence of the beam.

Certain limiting dimensions and weights are specified for the lamphouse, together with fully detailed dimensions for the spigot mounting. The standard also lays down such electrical requirements as will ensure efficient operation and safety in use.

Copies of this British Standard may be obtained from the Sales Department of the Institution, 2 Park Street, London, W.1, price 2s. 6d.

FACTORS AFFECTING 16mm. PICTURE ILLUMINATION AND QUALITY

D. S. Morfey, B.Sc. A.C.G.I.*

Read to a meeting of The British Kinematograph Society on November 4, 1953

MOST users of 16mm. projectors agree that one of the greatest needs at the present time is for a better quality picture. The field of 16mm. applications is, in fact, limited by the picture; as far as sound is concerned, it is comparatively easy to provide for an audience of 1,000 people even from portable equipment, but the picture limit is only about 200 to 300 people, if a good standard is to be maintained.

Continual efforts are being made by projector manufacturers to improve the illumination and quality of 16mm. pictures, and much information has been published on particular factors from the light source to the screen. The purpose of this paper is to review some of the factors involved, and to indicate the limiting feature of each. It will not be possible to deal exhaustively with these factors which cover a very wide field including the physicist and optician as well as the engineer.

In considering the factors affecting picture illumination and quality, it will be convenient to follow the same path as a ray of light passing through a projector from the light source to the screen and back to the audience, viz.:

- (1) The light source;
- (2) the condenser system;
- (3) the intermittent mechanism;
- (4) the projection lens; and
- (5) the screen.

The most important factor affecting picture quality, the photography of the film, must be omitted from this paper.

Screen Illumination

The limiting factor for 16mm. projectors, especially portable models, is lack of light. 16mm. picture brightness with the usual matt white screen is generally well below the ideal of about 10 foot lamberts, and the illumination

is often below 6 ft. candles,[†] the B.S.I. lower limit for 16mm. projectors. For example, a projector may well be giving not more than 220 lumens with a slightly blackened lamp, in which case the brightness would be only 2.4 ft. candles, assuming 80 per cent. reflectivity, on a 10-ft. wide screen, which is often used nowadays.

It is noticeable that the B.S.I. figure of 6 ft. candles for 16mm. projector performance is in itself an admission of weakness, as there is no reason why the 16mm. standard should be lower than 35mm. standard, which has a 9 ft. lambert minimum. In addition, high screen illumination is particularly required for semi-daylight classroom conditions.

The factors affecting screen illumination may be summarized as follows:

- (1) The brightness, shape and size of the source;
- (2) the aperture of the optical system;
- (3) the efficiency of the shutter, and
- (4) the efficiency of the screen.

In discussing these there is more to be said about limitations than achievements; any really useful increase in screen brightness must await a new light source or screen.

Light Sources

The characteristics of a light source which affect its suitability for use in a projector are:

- (1) Peak and average brightness;
- (2) brightness distribution and size;
- (3) polar diagram of energy distribution in all directions, and
- (4) spectral energy distribution (colour rendering).

[†] This refers to draft recommendations for projector performance. The corresponding screen brightness would be 4.8 foot lamberts, assuming a reflectivity of 80 per cent.

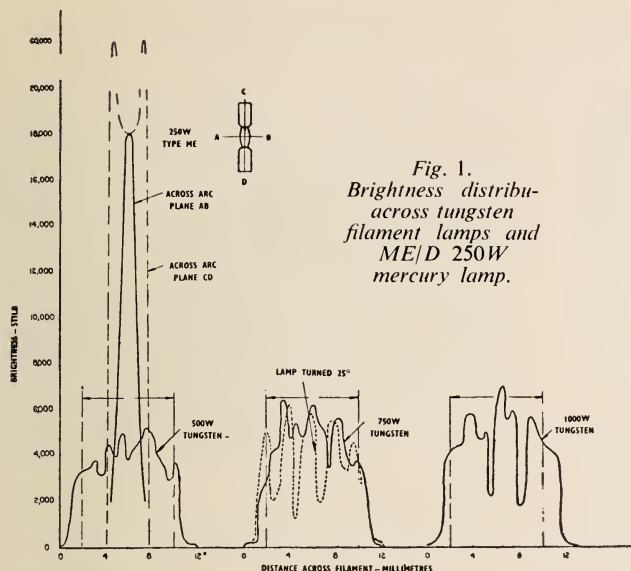


Fig. 1.
Brightness distribu-
across tungsten
filament lamps and
ME/D 250W
mercury lamp.

The influence of these characteristics on picture quality will be examined, using as examples three widely differing light sources, the tungsten, mercury and xenon lamps.

Source Brightness

Screen brightness is proportional to source brightness, which should, therefore, be as high as possible. The brightness of a source should not be confused with its candle power or lumen output which is of no importance in a projector. For example, an ordinary domestic lamp may emit a large number of lumens, but would be useless in a projector. Unfortunately, the published performance figures for projector lamps generally refer to the lumen output, not the brightness.

The best light source available as regards brightness is the carbon arc, which may give 40,000 to 100,000 candles/sq. cm.

For portable equipment, we must be content with only about 3,000 candles/sq. cm. in the tungsten filament, although peak brightnesses of about 18,000 candles/sq. cm. are available in lamps such as the 250W mercury discharge lamps. In spite of their disadvantages these lamps give an appreci-

ably brighter picture, as may be seen by comparison with a 750W tungsten lamp. In addition, the life of the lamp is up to 500 hours.

Brightness Distribution and Source Size

Light sources used in portable 16mm. equipment are unfortunately very uneven, as may be seen from the projected images of a 750W tungsten filament lamp and a 250W ME/D mercury vapour lamp.

The brightness across the tungsten filament and mercury sources is shown in Fig. 1. This shows that the average brightness is much lower than the peak, which in itself is unimportant.

In the case of the tungsten biplane filament the condenser collection angle may be about $\pm 40^\circ$; if the lamp is twisted round through this angle, it can be seen that gaps appear between the filaments, again lowering the average brightness. This is also shown in Fig. 1.

The mercury and xenon experimental discharge lamps each have small sources of high peak brightness reaching about 18,000 candles/sq. cm. This, however, refers only to the centre region, which is much too small to work the optical system at full aperture.

The size of the source is another important factor affecting screen illumination. The effective source size required depends upon the design of the optical system—the important point being that the source with the condenser system must cover the film gate, and

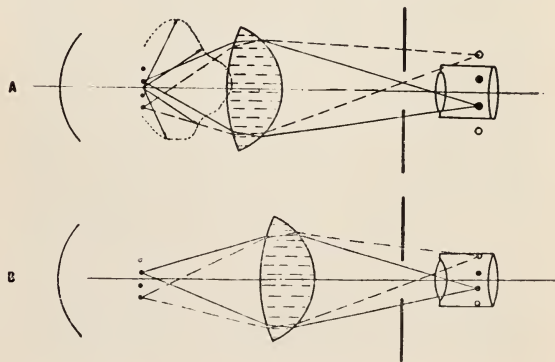


Fig. 2. Simplified optical system with large source.
(A) High magnification.
(B) Low magnification.

must operate the projection lens at its full aperture if maximum efficiency is to be obtained. Provided that the source is big enough to fulfil these conditions, nothing is gained by making it larger and consuming more power. This is made clear by reference to a simplified diagram of the optical arrangement generally used in portable projectors with sources of uneven brightness. (Fig. 2). In these cases the image of the source is arranged to fall inside the projection lens; when the source is uniform, as in the case of the carbon arc, the source image is arranged to fall on the gate.

In the case of a large source, it will be noticed that light from the end coil is either cut off by the gate, or, if the condenser is close to the gate, the image falls outside the projection lens. In either case the light from the end coils is wasted. Provided the light source is big enough to suit the magnification of the condenser system, which should be as high as possible, no extra light will be thrown on to the screen by using a larger and more powerful lamp.

If a low magnification system is used by moving the condenser away from the lamp, as shown in Fig. 2(B), then a large source can be used, but the collection angle is reduced and apart from a small increase due to using the centre region on the polar diagram, the screen illumination remains unchanged.

Comparison of a sample 500W, a 750W and a 1000W lamp shows that the average source brightness of the 750W and 1000W lamps is approximately the same, the 500W lamp being rather lower because it has an older type of filament construction. The measurements on sample lamps are :

Source Brightness	Av. Screen	
	H.C.P.	F/C
500W 2720 candles/sq.cm.	2016	37.6
750W 3530 candles/sq.cm.	3390	45.6
1000W 3540 candles/sq.cm.	4580	45.3

The screen brightness figures are proportional to the source brightness figures and not to the watts consumed—resulting in a similar performance for the 750W and 1000W lamps. This is because the magnification in this case is big enough for the 500W source—in practice the larger 750W source gives a useful margin of error, but there is little to be gained by using the 1000W lamp.

The suggestion has been made that a "point" source would be ideal for a projector. This is not the case as such a source would either fail to fill the screen, or would fail to fill the projection lens, which would then be working inefficiently at a very small aperture.

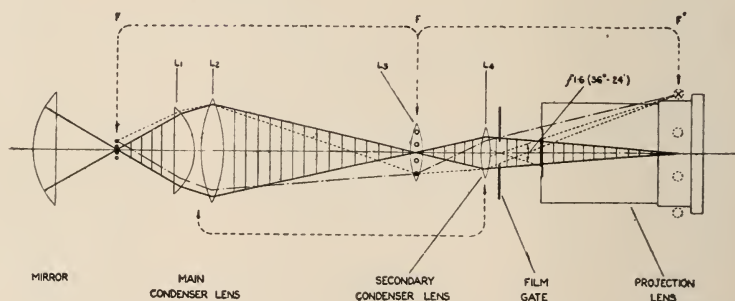


Fig. 3. B.T.H. 16mm. projector optical system.

Fairly small sources are sometimes used with a suitable optical system, but only when the brightness is sufficient to compensate for the decrease in effective aperture. The 250W ME/D mercury vapour lamp is an example, its source being practically a "line" measuring about $3\frac{1}{2}$ mm. by $1\frac{1}{4}$ mm.

It is an easy matter to check whether the projection lens is working at full aperture by observing whether the front glass appears filled with light. In the case of the mercury lamp the lens is not working at its full aperture, but this is compensated by its high brightness.

When using very small sources, as in enclosed arcs, the optical arrangement shown in Fig. 2 is not suitable for even screen illumination, the gate being a long way from the condenser. This difficulty can be largely

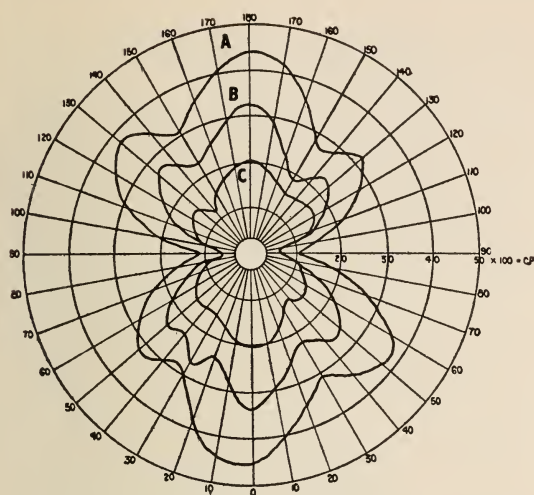
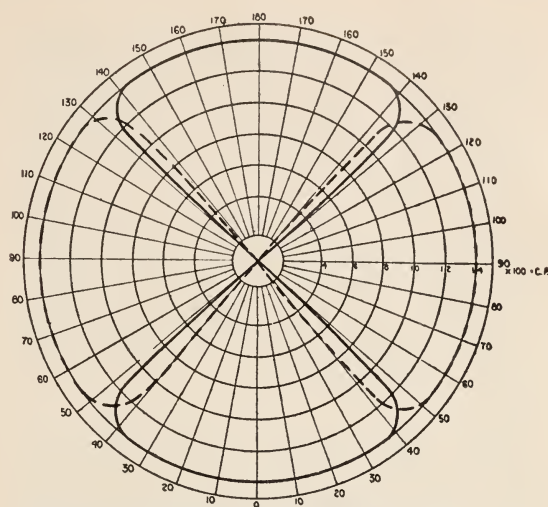


Fig. 4. Polar curves of light distribution from tungsten filament lamps.

(A) 1,000W, (B) 750W and (C) 500W.



Distribution in Horizontal Plane through centre of lamp ———
Distribution in Vertical Plane 0°-180° through axis of lamp - - - -

Fig. 5. Polar curve of light distribution for 250W mercury lamp.

overcome by using a "relay" optical system (Fig. 3) in which a secondary condenser is placed very close to the gate so that the uneven source is completely out of focus.

Polar Diagram of Light Distribution

It is evident that greater efficiency is gained by using a small source working at a large magnification, provided that the required optical conditions are met. In practice, the magnification may be limited by the polar diagram of light distribution from the lamp.

Figs. 4 and 5 show the light distribution from tungsten and 250W mercury lamps. In the case of the tungsten lamp the light extends in a wide angle round the lamp, and the magnification is limited by the difficulty of making very wide aperture condenser lenses without excessive transmission and aberration losses. The vertical polar diagram of the mercury lamp shows that the light does not extend beyond about $\pm 40^\circ$, so that the collection angle in this plane is limited.

Spectral Energy Distribution

Tungsten and carbon arc sources have a continuous spectrum, and are quite satisfactory as regards colour rendering. In the

case of the mercury lamps the colour rendering is unsatisfactory because the light occurs at a few particular wavelengths instead of continuously. For this reason, the colour rendering cannot be corrected by filtering. Improved colour can be obtained by the addition of cadmium but the results are still not entirely satisfactory.

It should not be inferred that discharge lamps cannot give good colour rendering. The xenon lamp, a new type recently tried in a portable projector, is fully colour corrected and has a life of about 250 hours. The source shape of the A.C. lamp is similar to the mercury lamp but may be used with the relay optical system. Unfortunately this lamp requires heavy and expensive control gear, which is the main reason that it has not passed beyond the experimental stage.

Other light sources have been tried, such as the zirconium arc, but there seems no possibility of the tungsten filament lamp being superseded for portable projectors. Efforts are being directed more to improving the overall efficiency from the lamp to the screen, which at present is less than 5 per cent.

Effect of Mechanical Design Picture Quality

The intermittent mechanism must move the film 24 times per second with an accuracy

of 0.0007-ins. to keep within the B.S.I. limits of picture jump. In addition, the time required to move each frame must be kept to a minimum to keep the shutter as small as possible, and the film must be moved without objectionable film "click."

Many efficient designs have been evolved to meet these requirements. Fig. 6 shows a method of eliminating the effect of backlash and wear by means of a spring return system for both the "up and down" and insertion movements of the claw, which is fitted with tungsten carbide tips.

Flicker

Good picture quality demands freedom from "flicker" at both 24 and 16 frames per second. The shutter requirements to achieve this with a minimum loss of light are well known; the shutter must repeat its cycle at least 48 times per second, and the flicker blade must be as big as the "pull-down" blade—any attempt to reduce it to improve illumination will result in the 24-cycle repetition rate of the larger blade being seen as flicker.

For maximum efficiency the shutter should operate in a narrow part of the light beam and the linear speed of the blade should be as high as possible. The shutter is therefore made as large as possible and may rotate two revolutions per frame.

Definition of 16mm. Film and Lens Resolving Power

We now come to the film—certainly the most important factor affecting picture quality. It is outside the province of this paper to discuss the picture itself—the job of the projector designer is to present what is on the film with the minimum loss. But it is interesting to examine the standards of definition achieved.

Jesty and Phelps have dealt with this subject in some detail in their paper to this Society¹ in which definition under varying conditions of contrast, brightness and viewing distance is discussed. Three of the conclusions are that:

- (1) The maximum resolution of a 16mm. commercial reduction print

viewed at low magnification is 49 lines/mm. on the film;

- (2) the maximum resolution by projection from a 16mm. reduction print under the best conditions and at zero viewing distance is only 30 lines/mm. for commercial prints;*
- (3) with brightness quarter optimum, contrast 0.4 and the viewing distance 4 times screen height, which is a normal set of conditions, the

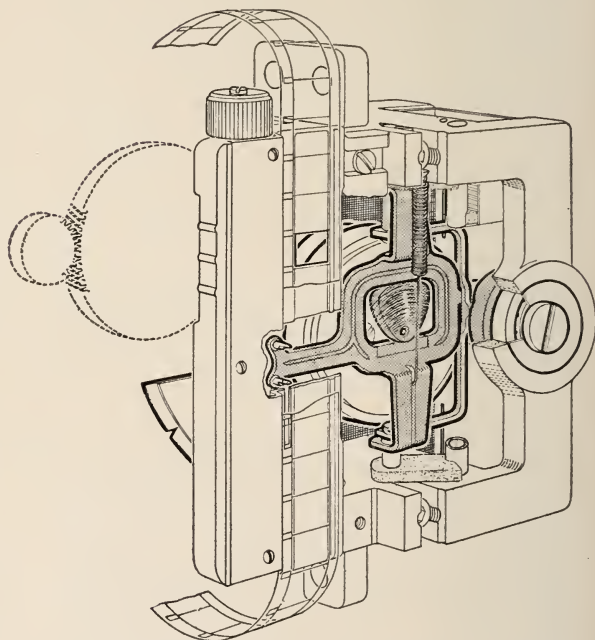


Fig. 6. *Intermittent mechanism for B.T.H. "401" 16mm. projector.*

effective resolution of a commercial reduction print is only about 13 lines/mm.

These results are surprisingly low, and constitute one of the main factors which limit 16mm. picture quality, and is so evident when comparing the definition of a 35mm. and 16mm. picture. (This, of course, is due to its larger size—in terms of lines/mm. the 35mm. film is similar to 16mm. film).

* It is interesting to note that this agrees closely with the limitation of high frequency on the sound track, which is about 7000 cycles/second corresponding to 38 lines/mm. resolution.

A 16mm. test film of a definition pattern was made by reduction printing from a 35mm. negative, care being taken at all stages to get the best possible print. This confirms Jesty's results, having a resolution of 38 lines/mm. when examined by a low power microscope, or 34 lines/mm. when projected and viewed close to the screen. This may be demonstrated with the aid of a 5-glass "field flattener" lens which has a resolving power of more than 100 lines/mm. in the centre and 60 lines/mm. to the sides, so that definition losses due to the lens may be ignored. The capabilities of the lens may be confirmed by the projection of a stationary graticule at reduced brightness.

Projection of the 16mm. film shows that the maximum resolution under the best conditions is only about 34 lines/mm., due almost entirely to the film in this case. Jesty has explained that lower contrast, screen brightness and greater viewing distance will make the effective resolution even lower.

As normal projection lenses of 2-inch focal length and upwards have a resolving power (except in the extreme corners) which is much better than the film resolution, it follows that, for these focal lengths, the film and not the lens limits the definition. This is borne out by comparing the performance of the special 5-glass lens with that of a standard 4-glass cemented doublet type f1.5 lens when projecting a section of commercial film.

Comparison with a graticule shows that the resolving power of the 5-glass lens is far superior to that of the standard lens, especially in the corners. When projecting the film, however, there is no apparent improvement in definition from the 5-glass lens.

Contrast

Experience shows that loss of contrast due to the projection lens can easily offset any improvement due to greater illumination. The contrast of a lens should certainly be taken into account when considering lenses of very wide apertures such as f1.2, which may have as many as 8 air/glass surfaces. Loss of contrast may be observed when projecting the graticule with the 5-glass lens,

because of its extra air/glass surfaces. It would seem undesirable to sacrifice contrast to achieve wide apertures and very high resolution in the lens, while the definition is at present limited by film.

Screens

The function of the screen is to reflect as much as possible of the light back to the audience. That is, the screen should keep the light off the floor and ceiling, and spread it in a flat "fan" over the audience.

Although such screens are not yet available, the latest type of high reflectivity "silver" surface can give a useful increase in brightness, up to angles of about 25° on each side of the centre line, Fig. 7.

A compromise must be made between reflectivity and the width of the polar diagram, depending on the shape of the hall, but

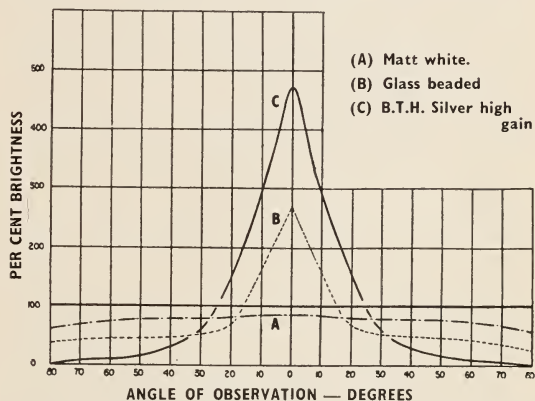


Fig. 7. Reflectivity curves of screens. The perfect diffuser is, of course, at 100 per cent brightness.

it does seem that there is room for improvement in screens if they can be designed to have a narrow polar diagram in the vertical plane and a wide diagram in the horizontal plane.

Conclusions

As regards future developments, the greatest advance for portable equipment may be towards improved directional screens, unless a new light source can be discovered which fulfils the required conditions.

The prospect for static 16mm. projectors is better, for with a carbon arc the limitation is mainly one of film heating, and various

methods such as selective filters and dichroic mirrors may be used to raise the present standard.

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1. Jesty, L.C., and Phelps, N. R. "The quality of television and cinematograph pictures," *Brit. Kine.*, **22**, 104, 1953.

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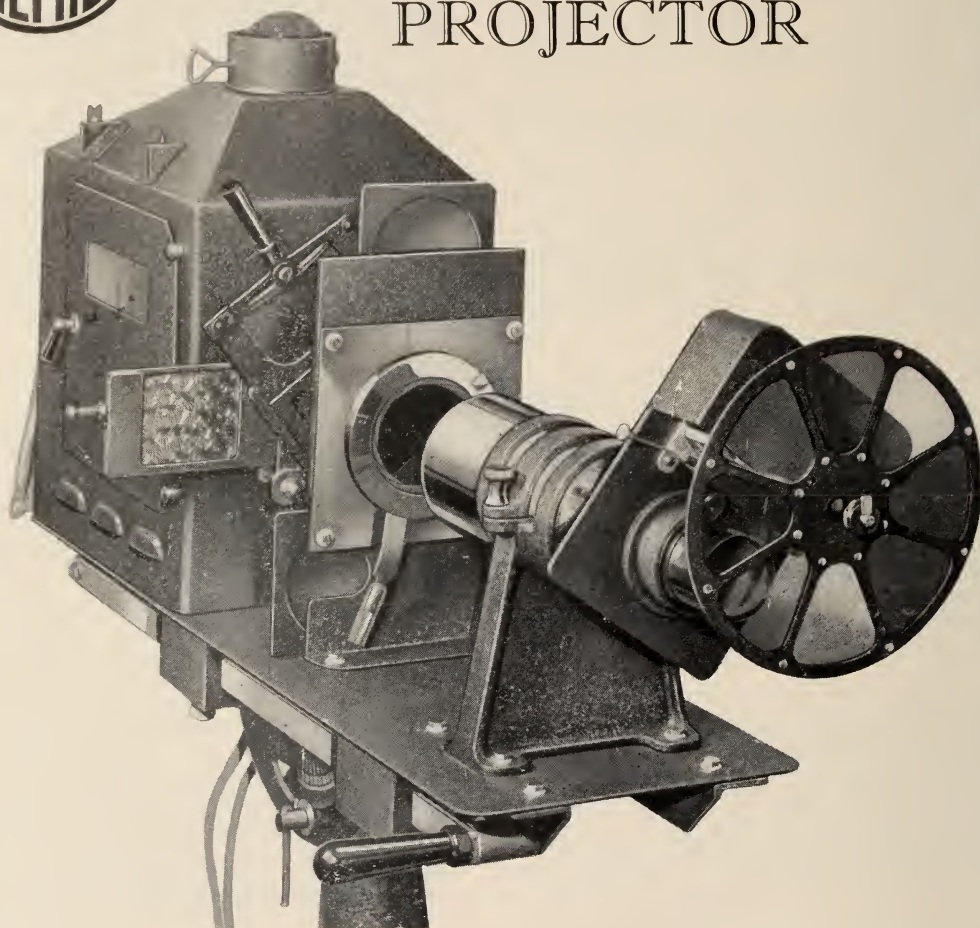
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